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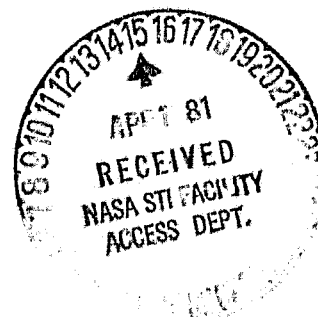
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IMPACT OF IMPROVED INFORMATION
ON THE STRUCTURE OF WORLD GRAIN TRADE

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IMPACT OF IMPROVED INFORMATION
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I. Introduction

A. The Problem and its Origin

This report addresses the question of the benefits to be derived by the U.S. from improvements in our global grain crop forecasting capability and of how these benefits would be distributed. Improvements in forecasting grain crops in some countries may depend heavily on satellite technology because timely information on crop conditions is not published by these nations and the ability of foreigners to observe crop conditions first-hand is restricted.

The importance of having a better grain production forecasting capability on a global scale was emphasized by the series of poor world grain crops between 1972 and 1977 and the consequent instability in world grain prices. The problem was especially troublesome in large grain producing and consuming countries, such as the USSR and the PRC, where the ability of people from outside these countries to observe crop conditions directly and frequently was and still is severely limited. As long as the U.S. capability to observe crop conditions first-hand is limited, there will be great interest in basing crop forecasting on satellite technology. However, interest in this technology may extend even to countries where information on crops is more comprehensive because improved satellite technology may help achieve more accurate and timely production estimates by supplementing current methods.

In recent years, considerable progress has been made in demonstrating the social value of more accurate information about crop production. The pioneering work of Hayami and Peterson^{1/} presented a theoretical and empirical basis for measuring the socially optimum level of expenditures on crop forecasting, for a given level of forecasting technology. Their analysis is based on the total welfare gains of producers and consumers, but it neglects storage costs of maintaining inventories.

More recently, Bradford and Kelejian^{2/} extended the work of Hayami and Peterson. Their analysis permits the calculation of separate benefits to producers, consumers, and inventory holders in terms of consumers' surplus, inventory holders' profits, farmers' receipts, and storage industry surplus (rents). This study and an analysis by Andrews^{3/} have been used by NASA in estimating the net benefits of improving crop estimation through the use of better satellite technology.^{4/}

The NASA analysis assumes that no tariffs or trade restraints exist and that there is free trade in grains.^{5/} As will be seen shortly, trade barriers, together with other policy factors, make it difficult to directly link changes in production-consumption balances to trade levels.

Another problem with the welfare analyses is that they present gains or losses for large groups of people -- e.g. producers or consumers. While these measures are valid, they shed little light on how people within these groups can be affected differently during a given period of time, how popular perceptions of benefits or losses may differ from those derived from theory, and how the interests of various groups manifest themselves pressures for or against political action.

An example will illustrate the practical nature of some of these difficulties. The timing and accuracy of information affects the behavior of market prices over time. In the summer of 1972 when the USSR began to make large wheat purchases, the market was not generally aware of the magnitude of these purchases. Wheat producers who sold their wheat early in the marketing season received relatively low prices. When the USSR's buying intentions became more widely known, wheat prices rose sharply and producers who sold later in the season benefited greatly from the higher prices. The demand for "political action" did not come from all wheat producers. Rather, it emanated from those who sold their wheat early and cheaply. Thus, while wheat producers as a whole benefited from higher prices in the 1972-73 marketing season, it was virtually impossible to convince those who sold early of this benefit.

B. Study Objectives and Approach

The basic objective of this study is to analyze the benefits that would flow to various groups from a specified degree of improvement in forecasting grain production. The improvements in forecasting accuracy would come from the use of satellite technology in conjunction with existing ground-based estimating procedures. The degree of forecasting accuracy to be obtained from satellite technology has been specified by NASA and employed in this study.

The study focuses on wheat production in seven countries/regions: the United States; Canada; Australia; Argentina; Western Europe; the USSR; and all other countries as a group. This country/region breakdown is consistent with that used by USDA in its estimates of world production.

While the primary focus is on wheat, some attention is also given to other grains, particularly when they are substitutes for wheat. In many regions of the world, wheat and other grains are substitutes in both human consumption and animal feeding. In addition, factors affecting wheat production may also affect production of other grains. For these reasons, an analysis of forecasting accuracy for wheat production has to recognize the supply-demand balance for other grains as well.

This analysis is retrospective in nature. We assume that an improved production forecasting technology was in place prior to 1972 and that its capabilities were generally recognized. We thus describe how the new forecasting technology would have improved available information during the 1972-77 period, recognizing that the information systems actually used were improved during this period. The assumed improvement in information will be analyzed with respect to its impact on market price behavior, prices received by producers and paid by consumers, trade flows, and government policy decisions.

Section II of this report discusses the nature of the world trade in grains. The operation of the private international grain trade is covered in Section III. The flow and utilization of information during the 1972-77 period is described in Section IV. Sections V and VI analyze the impact of an improved information system. The last section deals with U.S. policy implications of having and utilizing better crop forecasting technology.

Footnotes

1/ Y. Hayami and W. Peterson, "Social Returns to Public Information Services; Statistical Reporting of U.S. Farm Commodities," American Economic Review, vol. 62, 1972, pp. 119-130.

2/ D. Bradford and H. Kelejian, "The Value of Information for Crop Forecasting in a Marketing System: Some Theoretical Issues," Review of Economic Studies, vol. 44, no. 3, 1977, pp. 519-531.

3/ J. H. Andrews, "Economic Benefits of Improved Information on World-wide Crop Production," NASA Contract NASW-2558, Report 76-243-1A, ECON, Inc., Princeton, N.J., April 7-15, 1977.

4/ The application of the approach of Bradford and Kelejian and Andrews are described in A Cost-Benefit Evaluation of the Landsat Follow-on Operational System, X-903-77-49, Goddard Space Flight Center, Greenbelt, Maryland, March 1977; and S. Ahmed Meer, Estimating the Economic Benefit of Global Systems: The Landsat Follow-on Cost/Benefit Study, X-903-78-24, Goddard Space Flight Center, Greenbelt, Maryland, August 1978.

5/ ECON Presentation to Schnittker Associates on the ECON-NASA Integrated Wheat Model, November 17, 1978.

II. Nature of World Grain Trade

This section of the report describes how government policies affect international trade in grains and describes the major exporting and importing countries and their grain marketing systems. The discussion provides a basis for judging the competitive nature of international trade in grains.

A. Government Intervention in Agriculture

Governments in almost all countries are involved in one way or another with agriculture through policy interventions, although these interventions vary in nature and degree among countries. In the case of grains, they range from nearly total government control of production, distribution, and international trade (as in the USSR or the PRC) to policies aimed at supporting farm prices and incomes but employing little government involvement in internal or external trade (as in the United States or the European Economic Community (EEC)). For purposes of this study, general agricultural policies are taken as given.

In most developed market economies, policy interventions are designed to support farm prices or incomes above those that would prevail under purely competitive market conditions. Similar policies are followed by some developing countries for some commodities; but, more typically, developing countries follow policies that keep the consumer price of food low and depress farm prices below world market levels in the process.

These various policy interventions require trade restrictions of one form or another. In cases where producer prices or incomes are supported,

trade restrictions such as import quotas, tariffs, variable levies and export subsidies are required. Where domestic prices are kept below world market levels, export taxes or subsidized prices resulting from excessive imports and a variety of domestic measures are employed.

Trade interventions other than tariffs can destabilize world market prices. They insulate countries from the world market to varying degrees and prevent world price changes from fully influencing either production or consumption in the protected countries. Not only do such policy interventions influence the level of world trade, but they make it difficult to relate changes in production to changes in trade through the use of any of the simple global free trade models.^{1/}

Other forces also interfere with the link between production and consumption in a country and its level of exports or imports. Many developing countries and some centrally planned economies have foreign exchange shortages and cannot fully meet their food import requirements, especially in periods of large production shortfalls. In such times, meeting domestic food deficits would require interruption of nonfood imports, and some countries would rather maintain the level of industrial imports and absorb temporary reductions in food supplies.

In other situations, the transportation, storage, and distribution facilities are inadequate for countries to use imports to fully offset declines in domestic production. This is especially true in many developing countries. For example, during the severe Sahelian drought of the early 1970's, it was physically impossible to import all the needed food, even though it was available to the region.

Knowledge about the level of grain stocks and how they are managed in many countries is very incomplete. This is especially true for Communist countries that treat information about their stocks as a state secret for national security reasons. While we know that the USSR and the PRC maintain sizable grain reserves, the size of these reserves and how they are managed remains obscure.

Finally, food exports from some countries may be dictated by factors other than availabilities and world prices. In some situations, countries may export grain for reasons of foreign policy, and these exports may bear little relationship to supplies and prices. In other cases, the lack of storage or the need for foreign exchange may result in export levels in excess of those determined purely by market price prospects. And in still other situations, the inability to physically move grain into export may reduce a country's exports below that indicated by world price levels and domestic availabilities.

Government policies may be used in ways that introduce elements of noncompetitive behavior in world markets, particularly in the longer-run. Both McCalla and Taplin^{2/} presented analyses to show that in the 1960's the U.S. and Canada behaved as duopolists with the objective of maintaining historic market shares. A degree of stability is added to the duopoly behavior of the U.S. and Canada by their willingness to hold stocks in times of large supplies. McCalla indicated in his analysis, which applied primarily to the early 1960's, that Australia could become important if its production increased and it, too, were willing to hold supplies off the market in times of large production. This development has occurred

to a large extent, and Alaouze, Watson, and Sturges^{3/} argue that the world wheat market today can be categorized as having a triopoly structure.

The means of grain trade varies considerably among countries and reflects government policies. In the Communist countries, international grain trade is carried out by state monopolies; and in some developing countries such as India, it is also handled by the Government. In most other major non-Communist grain importing countries, international trade in grain is conducted by private firms. Such countries include those of Western Europe and Japan in the case of coarse grains. Japanese wheat imports are handled by the Food Agency, a government monopoly.

Among the major grain exporters, only the United States has a system totally dependent upon the private trade. Other exporting countries rely to varying degrees on export monopolies.

In Canada, the Wheat Board monopolizes export sales of wheat and coarse grains, although the private trade is involved to some extent in executing these sales. The Australian Wheat Board has complete monopoly power over wheat exports, and coarse grain exports are made by a combination of marketing boards and private firms. Until recently, grain export sales from Argentina were made almost entirely by the Government; however, private firms have become more directly involved in export sales in recent years.

B. Major Exporting and Importing Countries

World trade in grain has grown rapidly since 1960, and particularly after 1970. Based on the country/region groupings presented in Table 1, world exports of wheat increased by 71 percent between 1960 and 1977, or

by 3.2 percent a year. However, there have been large annual variations about the growth trend. For coarse grains, world exports increased by 322 percent, or by 8.8 percent a year between 1960 and 1977, as shown in Table 2. The annual growth rate between 1960 and 1970 was 7.7 percent, compared to 10.9 percent for the 1970-77 period.

The growth in wheat trade reflects an increase in food demand that has been growing most rapidly in the developing countries with high rates of population growth. The growth in coarse grain trade reflects rapidly growing demand for livestock production in the developed countries, the USSR, Eastern Europe, and the high-income developing countries.

The U.S. is the major wheat exporter, followed by Canada, Australia, and Argentina. In 1977, the U.S. supplied 53 percent of total world wheat exports, about the same share it had in 1960. The developing countries experienced high rates of growth in imports. In 1960 these countries accounted for 32 percent of world imports, but by 1977 they accounted for 51 percent of total world imports. In recent years the PRC, the USSR, and Eastern Europe have also become major wheat importers.

The U.S. is the dominant exporter of coarse grains. Its share of world exports grew from 57 to 71 percent between 1960 and 1977. Argentina is the next largest exporter, but its exports in 1977 were only one-fifth the U.S. level. The major importing regions are Western Europe, Japan, and the USSR. European imports have been fairly steady in recent years, while those for Japan and the USSR have trended upward.

Table 1

<u>World Trade in Wheat</u>					
	<u>1960</u>	<u>1965</u>	<u>1970</u>	<u>1975</u>	<u>1978</u>
	- - - - - million metric tons - - - -				
<u>Country/Region</u>					
U.S.A.	-17.7	-23.6	-19.9	-31.6	-30.3
Canada	- 9.3	-14.9	-11.5	-12.3	-16.3
W. Europe	11.5	5.2	7.8	- 3.1	0.6
Oceania	4.8	- 5.4	- 9.4	- 8.5	- 8.3
Japan	2.8	3.4	4.8	5.9	5.8
South Africa	0.1	0.2	0.2	(-)	- 0.2
E. Europe	5.0	6.3	5.8	4.0	3.1
U.S.S.R.	- 4.4	5.9	- 6.7	9.6	5.9
P.R.C.	1.9	6.3	3.6	2.2	8.6
Other Comm.	0.4	0.6	1.2	1.1	1.5
Argentina	- 1.9	- 7.9	- 1.6	- 3.2	- 1.7
Brazil	2.0	2.3	1.8	3.8	3.6
Thailand	(-)	(-)	0.1	0.1	.2
South Asia	5.2	9.1	4.0	10.5	2.7
Low Inc. LDC's	3.7	6.3	8.6	11.3	14.1
Mid Inc. LDC's	1.9	1.3	3.1	2.9	3.3
Hi Inc. LDC's	<u>2.5</u>	<u>2.8</u>	<u>5.5</u>	<u>7.9</u>	<u>10.2</u>
Total Exports	33.3	51.8	49.1	58.7	56.8

* (-) indicates less than 50,000 tons. Minus signs before figures denote exports.

Table 2

<u>World Trade in Coarse Grains*</u>					
	<u>1960</u>	<u>1965</u>	<u>1970</u>	<u>1975</u>	<u>1978</u>
	- - - - - million metric tons - - - - -				
<u>Country/Region</u>					
U.S.A.	-10.6	-25.2	-19.1	-49.3	-55.8
Canada	- 0.4	- 0.6	- 3.9	- 4.3	- 3.5
W. Europe	14.3	23.6	20.7	19.8	20.1
Oceania	- 1.1	- 0.4	- 2.2	- 3.7	- 1.8
Japan	1.9	5.2	10.5	13.5	17.0
South Africa	- 1.1	- 0.4	- 1.0	- 1.5	- 3.7
E. Europe	0.2	2.6	2.1	3.8	7.0
U.S.S.R.	- 1.8	- 2.2	- 0.8	15.6	10.7
P.R.C.	0.7	- 0.2	(-)	- 0.1	0.1
Other Comm.	- 0.2	- 0.1	(-)	- 0.1	- 0.2
Argentina	- 2.6	- 3.8	- 7.6	- 7.1	-11.2
Brazil	(-)	- 0.6	- 1.9	- 1.5	- 1.5
Thailand	- 0.5	- 1.2	- 1.8	- 2.6	- 1.3
South Asia	0.2	1.2	-	0.7	0
Low Inc. LDC's	0.1	- 0.4	0.9	3.5	5.2
Mid Inc. LDC's	- 0.4	- 0.4	0.4	0.1	0.5
Hi Inc. LDC's	<u>0.4</u>	<u>0.4</u>	<u>2.2</u>	<u>5.6</u>	<u>8.4</u>
Total Exports	18.7	35.5	38.3	70.2	79.0

* (-) indicates less than 50,000 tons. Minus signs before figures denote exports.

C. Export Marketing Boards

Several of the large grain exporting countries, notably Canada and Australia, utilize marketing boards. The operations of these boards are discussed here.

Canada

The Canadian Wheat Board is a crown corporation and is the sole export seller of wheat, barley, and oats, Canada's principal export grains. The Wheat Board negotiates the sale and shipment for most of Canada's grain exports, although it also offers some of its grain to private exporters each year for resale in the open market.^{4/} The Wheat Board also implements some of Canada's agricultural policies.

A Minister of the Canadian Government maintains a continuous supervisory role over Wheat Board activities, which are subject to question and discussion in Parliament at any time. Large sales of grain, potential crop failures, loss of potential sales by the Board, and related issues are regularly reported and debated in Parliament.

While the Wheat Board operates in ways consistent with overall government policy, it has considerable latitude in exercising its export role. It can enter into multi-year sales agreements and has done so with countries like the USSR and the PRC. Since the terms of sales are treated as confidential and not made public, the Board has substantial flexibility in setting export prices for individual sales and in meeting competition from other exporting countries. The results for each marketing season are reported, but they represent an average for all sales made during the season and do not provide details on individual transactions.

Australia

The Australian Wheat Board, operating as an export monopoly, is the only authorized receiver and seller of wheat. The Board is a statutory corporation with 10 representatives of wheat growers on the Board and four representatives appointed by the Minister of Primary Industries (Agriculture).^{5/}

The Australian Wheat Board operates its wheat export activities in much the same way as its Canadian counterpart. Terms of individual sales are not made public, and it can and has entered into long-term sales agreements with importing countries. It is able to set export prices on individual sales at or below prevailing world market prices to assure export movement of wheat.

Barley is the other major export grain in Australia. Sales of barley are handled by state marketing boards in Western Australia, New South Wales, Queensland and combined board for South Australia and Victoria known as the Australian Marketing Board. The latter handles most of Australia's barley exports.^{6/}

As with wheat, the Boards are free to set export prices. This provides the Boards with authority to remain competitive in world markets and to ensure exports of available supplies.

D. Government Import Monopolies

All of the Communist countries utilize state trading corporations to handle both grain imports and exports. Although some other countries have state trading agencies for selected imports (the Japanese Food Agency handles all wheat imports and several government agencies in India

are involved in grain imports and exports), the Soviet system is described here because it is characteristic of how grain trade is handled in Communist countries.

The USSR's state trading corporation, Exportkhleb, is the sole exporter and importer of agricultural products. Exportkhleb is under the general supervision of the Ministry of Trade; it operates, under its own unique regulations, in somewhat the same fashion in respect to the government as the Canadian Wheat Board operates in respect to the Canadian government. Both are semi-autonomous corporate entities, carrying out business operations. In the Canadian case, the Wheat Board is semi-independent, and it is an exporter only, endeavoring to maximize returns to the producers who have supplied the grain and to achieve national economic and political objectives.

Exportkhleb, on the other hand, imports and exports at the direction of and for the account of the State, implementing decisions made by the government. In recent years, this agency has become predominantly an importer of grains and soybeans, but it continues to export sunflower oil, some grain, and other agricultural products.

The importance of state trading agencies in Communist countries arises from the way they buy or sell grain. They negotiate directly with exporters, whether they are private companies or export boards, and the negotiations are conducted in secret and on a bilateral basis. The state trading agency accepts what it thinks are the best offers available, and they typically do not indicate in advance what their import requirements will be. In contrast, other state agencies such as the Japanese Food

Agency and the grain buying agencies in India buy on a competitive bidding basis, and the quantities purchased and the prices paid are usually openly available to the market.

E. Private Grain Trade

The private grain trade accounts for a large part of world grain trade. Although data on global trade handled by the private sector are not available, some rough orders of magnitude can be obtained.

Estimating the size of private grain trade is difficult because different organizations are involved: private exporters sell to private importers and state trading organizations; and marketing boards may sell to private exporters, private importers, and state trading organizations that are importers. To simplify this analysis, exporters and importers are examined separately.

The U.S. is the largest grain exporter. In recent years, the U.S. accounted for over 50 percent of world exports of wheat and about 70 percent of coarse grains exports. Virtually all exports are handled by the private trade. The breakdown of U.S. exports by firm are presented in Table 3 for 1971 and 1975. In 1975, the top six exporters accounted for 82 percent of total U.S. grain exports, with the top three firms handling 53 percent. One of the leading exporters, Cook Industries went out of business in 1978, leading to further concentration of exports. On the other hand, some cooperatives and small private exporters have increased their volume of exports, although we do not know if their relative importance has increased.

Table 3

Percent of U.S. Grain Exports by Firm

	<u>FY 1971</u>	<u>FY 1975</u>
Cargill	28	19
Continental	21	17
Cook Industries	16	17
Louis Dreyfus Corp.	7	13
Bunge Corp.	8	8
Garnac Grain Co.	6	8
Toepfer	0	5
ADM	2	2
Peavey	0	2
The Andersons	1	1
Early & Daniels Int'l.	0	1
Central Soya	0	1
Other	<u>11</u>	<u>6</u>
	100	100

Source: Kenneth Towl, Cargill Inc.: Managing Corporate Public Policy in a Changing External Environment (Boston: Intercollegiate Case Clearing House, 1977).

All of the leading U.S. exporters operate on a worldwide basis, exporting grain from many other countries as well. Thus, in terms of volume handled, these companies are larger than indicated by the volume of U.S. grain exports.

The private trade handles a large portion of the grain exports from several other major grain exporting countries, including Argentina, South Africa, Thailand, Western Europe, and several smaller exporting countries. As already mentioned, the Canadian Wheat Board also sells some of its grain to the private trade.

We estimate that private firms handle well over 50 percent of world wheat exports and 70 percent or more of coarse grain exports. The private trade is somewhat less dominant on the import side because of the role of state trading agencies in the Communist countries and in some other nations.

Western Europe is one of the largest grain importing regions and most of this region's imports are handled by the private grain trade. In Japan, importation of coarse grains is carried out by the private trade, and private firms play an important role in handling grain imports in many other countries as well.

Footnotes

1/ D. Gale Johnson, World Food Problems and Prospects, (Washington, D.C.: American Enterprise Institute for Public Policy Research, June 1975), pp. 33-34; and "Limitations of Grain Reserves in the Quest for Stable Prices," The World Economy, vol. 1, no. 3, June 1978, pp. 289-299.

2/ A. F. McCalla, "A Duopoly Model of World Wheat Pricing," Journal of Farm Economics, vol. 48, 1966, pp. 711-27; and J. H. Taplin, "Demand in the World Wheat Market and the Export Policies of the United States, Canada, and Australia," Ph.D. Thesis, Cornell University, 1969.

3/ Chris M. Alaouze, A.S. Watson, and N. H. Sturges, "Oligopoly Pricing in the World Wheat Market," American Journal of Agricultural Economics, vol. 60, May 1978, pp. 173-185.

4/ For a description of the Wheat Board's operations, see The Report of the Canadian Grain Marketing Review Committee, Submitted to the Canadian Wheat Board, Winnipeg, January 12, 1971.

5/ Keith O. Campbell, Agricultural Marketing and Prices (Melbourne: Cheshire Publishing Pty Ltd, 1973).

6/ Ibid; also Lynn A. Austin, Australian Feed Grain Demand, USDA, ERS, FAER No. 140, November 1977; and Rural Industry in Australia, Bureau of Agricultural Economics, Canberra, 1975.

III. Private International Grain Trade

A. U.S. Firms and Foreign Subsidiaries

The private sector concerned with international trade in grains is very diverse. There are four or five large firms that operate on a global basis and buy from or sell to a large number of countries. While these firms have national identities in a legal sense, they are truly multinational operations. In addition, there are large numbers of smaller private firms that are almost exclusively importers or exporters in the countries in which they are based. While some of these firms may be fairly large in terms of the imports or exports of their own country, they are small in relation to the total volume of world trade.

Concern over the concentration in grain exports and the possibility of monopoly power in grain pricing is frequently expressed. Concentration in the grain trade does exist because there are few exporting countries and because a small number of private firms account for a large part of U.S. exports and total world trade.

With respect to wheat exporting countries, the case has been made that they behave as if each exporter could exercise some degree of monopoly power. This power grows out of the use of national policy measures to influence the country's position in world markets. In the past, major wheat exporters such as the U.S. and Canada have used export subsidies, export credits, and food aid programs to counter competition from other countries and to maintain their shares of the world market. If one country's share of the market increases, a major competitor

will take steps to regain its lost share.

But within the framework of government policies aimed at maintaining market shares, world trade in wheat and other grains is generally competitive. In the U.S., there is a high degree of concentration in the grain export business (Table 3), yet the markets for grains appear to have all the elements of a competitive industry:

- Large numbers of sellers and buyers (domestic and export);
- Homogeneous products;
- A fairly large number of small export firms competing with a relatively few large exporters; and
- Highly competitive futures market.

The existence of concentration in the grain export business, however, needs to be examined in the context of the competitive elements in grain markets. Caves argues that this concentration can be explained by the economies of scale related to information required to conduct international trade. He points out that:

Information is a fixed cost that can be spread over varying amounts of transactions, and information about trading locations is subject to increasing returns in the trading possibilities that it reveals. Also, the perishability of information creates scale economies to the maintenance of a continuous trading presence.^{1/}

Scale economies in information are reinforced by similar economies in transportation and key storage facilities. These economies permit risk-pooling within a firm.^{2/}

The major grain trading firms operate extensive global information and research systems that are strictly proprietary in nature. By most standards, these activities are large and efficient in the sense of providing management with timely information about crop prospects and trade opportunities. It is important that they have information about production and trade prospects before it is available to the general public in order to gain a degree of market advantage over competitors. Therefore, they devote considerable resources to gathering and analyzing information before it is made available by governments and international organizations.

All of the large firms have their own meteorological staffs which monitor world weather conditions. Information on temperature, precipitation, and other meteorological factors are gathered and analyzed on a daily basis. This weather information is relayed to staff agronomists who are familiar with weather-crop production interrelationships in each major grain producing area of the world. Some firms also employ yield forecasting models which relate weather factors to yield prospects. Together with information about planted and harvested area, this yield information provides a basis for making timely grain production estimates.

The large grain trading firms also have offices and staff in many countries, and their personnel are able to make first-hand observations about crop conditions which enables verification of information obtained from other sources. These same people also work closely with national governments and the private sector in many countries, preparing supply-demand balances for these countries and relating this information to export availabilities or import needs. The global information is analyzed at "headquarters" and assessments of trade and price prospects are made there.

The large private firms also have foreign subsidiaries in addition to their operating offices in other countries. The two large U.S. grain trading firms -- Cargill and Continental -- have foreign subsidiaries in Geneva. Bunge and Dreyfus are non-U.S. companies with large operations in the U.S. The foreign operations of the large trading firms have considerable operating autonomy; but, of course, the parent firm is kept fully appraised of their operations.

The use of foreign subsidiaries by U.S. exporters became important after the large growth in U.S. trade with the Communist bloc countries, particularly Russia, after 1972. Foreign subsidiaries apparently became an important vehicle for negotiating sales with Communist countries while keeping such information secret for a period of time. Communist state trading organizations evidently want to keep their purchases secret in order to be able to buy at the most favorable prices. Secrecy also enables exporters to cover their sales before they are publically announced. Under the export reporting system, to be discussed later, a U.S. company

does not have to report sales of foreign subsidiaries until these sales are formally transferred to the U.S. parent firm.^{3/}

B. Operation of the Private Trade

The business relationships among private firms in those countries where the private trade is important are conducted through competitive market practices. Both cash and futures markets are used to make sales and purchases. Buyers and sellers make their transactions on the basis of competitive bids, and these transactions are known in the market. Even purchases by some foreign governments or their designated public agencies are made on a competitive bidding basis, e.g., P.L. 480 sales, wheat sales to the Japan Food Agency, and many others.

U.S. futures markets are used by many foreign governments and foreign private firms to hedge purchases or sales of commodities of non-U.S. origin. Some countries use U.S. futures prices to price sales or purchases even though they do not use the futures market directly. For example, Thailand's corn exports to Japan are priced on the basis of a formula which relies on futures prices for corn in Chicago.

C. Government Trade Monopolies

Government trade monopolies sell to both private and government importers. With respect to the latter group of buyers, sales can be individual transactions or part of long-term sales agreements. A dis-

tinguishing characteristic of exports by trade monopolies to similar importing institutions is that the prices are rarely made public. This gives the export monopoly the ability to effectively compete on price, even to the point of selling below open market prices at times. In this way, export monopolies can have a competitive advantage over private firms. However, the prices received from sales to private exporters or importers are usually known to the market.

Export monopolies do not have to reveal when sales are made. It is usually known when these exporters have discussions with import monopolies, but it is not necessarily known when sales are actually made. However, export monopolies are agents for producers and it is usually in their interest to announce sales soon after they occur.

Import monopolies such as the Russia's Exportkhleb are the sole buying agents for their country. Typically, they do not buy openly in the market; rather, they arrange for imports from either export monopolies or private firms on the basis of negotiated prices. The import monopoly, however, observes open market prices and the prices they negotiate with exporters are fully competitive.

The import monopoly has a financial interest in not immediately revealing individual purchases, and may it not wish to reveal total purchase intentions. Commonly, they request (insist) that exporters, whether private firms or export monopolies, not reveal sales for some time so as not to bid up prices anymore than necessary. These practices can seriously distort market prices for up to several months. If significant quantities of grain have been sold but the information is withheld from the market, the price effect of these sales will not be fully realized. Only when the

sales are announced will nearly all of the market price impact be felt. In the interim, both exporters and importers can gain a temporary market price advantage.

In reality, even when sales are not formally announced, information is usually available through rumor or inference from the behavior of exporters. However, this is a very imprecise way of judging the size of sales.

Footnotes

1/ Richard E. Caves, Organization, Scale, and Performance in the Grain Trading Industry, Discussion Paper No. 546, Harvard Institute of Economic Research, Harvard University, Cambridge, Mass., April 1977.

2/ Ibid, pp. 22-23.

3/ The U.S. Export Sales Reporting System: Pertinent Issues, Prepared by the USDA Interagency Task Force, January 3, 1979.

IV. Information Flows on Wheat Production
and Trade, 1972-73 through 1977-78

The period of instability in the world grain markets, which began in 1972, had a widespread impact both in terms of the availability and cost of food supplies and in terms of confidence in the ability to manage food supplies in the future. One of the more significant developments early in this period was the realization that serious deficiencies existed in the collection and dissemination of information regarding the supply and demand balance for wheat and other grains. That is, while an improved information system could have done little to alter the level of grain production worldwide, it might have allowed more efficient management of available supplies. This probably could have resulted in more stable, if not lower, prices.

The events of 1972-77 forced a re-evaluation of and refinements in the global information system for grains. The collection and dissemination of information on world wheat production and trade logically occurs along two complimentary lines. In general, the flow of information is in regard to either supply or demand for agricultural commodities. While the U.S. has a long-established information system for domestic wheat production (along with other agricultural commodities), no such comprehensive system was in effect for the rest of the world in the early 1970's. USDA did not start to make regular periodic assessments of the world grain situation until 1973-74. The Soviet crop shortfall of 1972 and the resulting massive grain purchases, followed in subsequent years by events such as the failure of the Indian monsoon,

Chinese crop shortfalls and the Sahelian drought, all had a major impact on demand for U.S. grains. This further emphasized the need for a comprehensive and regular review of world production and demand prospects for grain, particularly wheat.

Related to assessments of the supply-demand outlook is the availability of actual data on the level of purchases of U.S. grains by the rest of the world. USDA began publishing data on U.S. grain sales in 1974, following action by Congress. Prior to that time, current information on export sales was unavailable. Information on the current rate of actual grain shipments was available, but this gave no reliable indication of future export demand patterns. Consequently, improvements in the global grain information system primarily were in response to events beginning in 1972. There is no question that the flow of relevant information has improved since then, or that it could be refined further. This chapter summarizes the flow of information affecting the world grain balance during the 1972-77 period.

A. Background

In the early 1970's, a series of events began to exert a major influence on the world food supply-demand balance. These events, beginning in 1972 with the decline in world grain production and purchases of U.S. grain by the Soviet Union, were almost universally unanticipated. The result was an extended period of instability in food supplies and agricultural prices.

In order to fully appreciate the instability of the 1972-77 period it is useful to contrast it with the previous decade. In earlier years,

the world had experienced an extended period of beneficial weather for crop production. Crop failures certainly had occurred, but typically were isolated geographically in any given year. Also, declines in USSR grain production were absorbed for the most part by reduced consumption rather than increased imports. The global decline in food production in 1972 was the first in two decades. Only two years later another decline in grain production was experienced.

Prior to the 1970's, significant advances in crop yields had been achieved through genetic improvements and increased use of chemical fertilizers and other inputs. However, by the end of the 1960's, the rate of increase in crop yields had begun to slow. Consequently, the production setbacks of the 1970's coincided with an apparent reduction in the advancement of crop production technology.

Prior to 1972, chronic grain surpluses were the norm in the developed countries. Production tended to exceed demand at prices supported through government programs. Surplus production potential resulted in either large stocks of grain or acreage withheld from production. Food production gains in the developing countries was mixed; however, a significant part of their growing food needs typically was met through transfers of food on concessional terms from the surplus producing developed countries.

The food and agricultural sectors of the centrally planned countries were isolated from world markets to a large degree in this earlier period. Trade in grains was marginal. Centralized control allowed domestic demand to be adjusted to available supplies. Significant production shortfalls

did result in expanded import requirements, but major adjustments typically occurred within the domestic economies, not on world markets. Moreover, the grain import needs of the two largest countries--the USSR and China--had been met from non-U.S. sources. Thus, the initial purchases of U.S. grain by the Soviet Union and China were unusual, both in their occurrence and their magnitude. As a result, the fluctuations in world food production, the large surge in grain trade, and the sharp depletion of grain stocks which occurred in the mid-1970's were to a large extent outside the realm of experience of the previous decade.

B. Chronology of Information Flow

1972

At the start of 1972, the world wheat situation was still perceived to be one of surplus. The previous U.S. wheat crop had achieved record yields and production. World wheat production during the July 1971-June 1972 marketing year was also at record levels. Beginning stocks of wheat of the major exporters in 1971-72 had fallen from the high level of the previous crop year, but were expected to rise over 10 percent by the start of the next season. World wheat trade in 1971-72 was expected to decline as a result of improved production in most importing regions.

The U.S. harvest in the fall of 1971 had recovered from the 1970 corn blight and reached a record far surpassing previous levels of production. Similarly, total world coarse grain production for 1971-72 had risen, and growing stocks were expected.

Thus, at the end of Calendar 1971, the available information on the

general outlook for the world grain balance again pointed toward surpluses.

However, at the beginning of 1972 certain factors existed that would have a significant impact on the level of demand for grain over the next year and beyond. These factors were generally known, but at that time they were perceived more as developments which would tend to help alleviate the apparent surplus supply outlook rather than produce a drastic reversal in the world grain situation.

Among the economic measures taken by the U.S. government in the last half of 1971 was the devaluation of the dollar. In effect, the cost to foreign consumers of U.S. agricultural commodities was reduced. Nevertheless, bumper crops and the slowdown in foreign economic growth presaged little immediate improvement in U.S. grain exports, and efforts were made to boost U.S. agricultural trade. This included initiatives aimed at East-West trade, particularly with the Soviet Union. A long-standing requirement that half of any U.S. exports of grain to the USSR and Eastern Europe had to be transported by U.S. flag vessels was lifted. As a result, in November 1971 the Soviet Union purchased \$125 million (about 3 million metric tons) of U.S. feed grains -- the first since 1964. In addition, foreign policy initiatives towards the Peoples Republic of China begun in 1971 increased the potential of future grain trade with that country.

In summary, by the start of 1972, there were indications of new demand. Information regarding abundant grain supplies appears to have been the overriding factor, however, as evidenced by the market prices for grains in the last half of 1971 and first half of 1972. In view of this assessment, the U.S. government policy reaction was to continue to restrict do-

mestic production while promoting efforts to expand exports.

The first indications of a changing grain supply picture began to emerge in early February 1972, when the U.S. agricultural attache in Moscow reported extensive damage to the Soviet winter grain crop. This raised the possibility that the USSR might enter world markets to buy sizable quantities of feed grains later in the year if production failed to meet targets. The occurrence of greater than usual winterkill was confirmed shortly thereafter by Izvestia. Also during February, the USSR negotiated a contract with the Canadian Wheat Board for the purchase of between 3.5 and 5.0 mmt of wheat for delivery by 1974.

During the winter and early spring of 1972, policy considerations within the U.S. government centered on approaches to foster Soviet purchases of U.S. grains. While the unquantified reports of potential USSR crop losses in 1972 indicated the probability of significant purchases, the principal focus of U.S. policy concerns appeared to be upon the means for, and domestic benefits of, expanding exports to the USSR rather than upon assessment of the potential destabilizing impact of a huge increase in Soviet imports.

This feeling continued through the spring of 1972 and was supported by the flat to declining trend of wheat prices during the period. Typically, heavy damage to Soviet winter grains had been largely offset by increased planting of spring grains. Information generally available to the world grain markets and policymakers tended to indicate a repetition of this historical pattern. However, in late March and in April, additional reports confirmed that winterkill had been extensive and that

conditions for spring plantings were unfavorable. Not only would much of the winter grain losses not be recovered, but serious problems appeared to be limiting the potential for spring sown crops.

During May and June, high level negotiations on grain sales were conducted at the summit meeting in Moscow and were followed by further talks in Washington. These resulted in the announcement in early July 1972 of the Soviet agreement to purchase a minimum of \$750 million of grain over the next three years. However, by that time the Soviets had already purchased 4.0 mmt of wheat and 4.5 mmt of corn valued at nearly \$500 million. By mid-August Soviet purchases totaled 11.8 mmt of wheat and 6.3 mmt of corn, and USDA did not appear to be aware of these large sales as they were being made by exporting firms. In addition to the purchases of U.S. grain, the USSR also exercised its option to purchase 1.5 mmt of Canadian wheat (adding to the 3.5 mmt bought the previous spring) and purchased 1.0 mmt of Australian wheat for delivery during September 1972 through May 1973.

As can be seen from the table on page 61, wheat prices rose sharply after July, reaching a peak in December 1972 that was nearly 80 percent above the harvest low prices in July. The "unexpectedly" large USSR purchases and the subsequent price increases generated considerable political pressure from wheat producers in the Southern Plain States who had sold a significant portion of their crop at harvest time. They had missed the benefits of the sharp price rise.

The initial comprehensive review of world wheat production by USDA in the fall (October) of 1972 was fairly close to the final estimate. However, the assessment of the world grain balance at the end of 1972

was considerably different than the outlook at the start of the year. In addition to the decline of 12 mmt in USSR wheat production, indications of grain production shortfalls (as yet unquantified) were appearing in other countries. India experienced a failure of its monsoon, and the rice crop declined sharply. The Chinese grain crop reportedly was lower than the previous year. Finally, the Australian wheat crop was suffering from a drought.

1973

The sharp rise in grain prices in the last half of 1972 caused public concern over escalating food costs. In response to these pressures, the USDA relaxed acreage restrictions for 1973 crops, but it did not remove them completely.

The periodic assessments of prospective developments in the world grain balance began in the spring of 1973 with USDA's first projection of 1973-74 world grain production. For wheat, the initial outlook (released in April 1973) for the 1973-74 crop was for a substantial increase in production, reduced international trade, and rising stocks by the end of the 1973-74 season. This assessment of recovery from the shocks of late 1972 brought lower prices in the first half of the year. U.S. wheat prices (farm level) declined from a high of \$2.38/bu. in January 1973 to \$2.15/bu. in May.

The initial forecast for improved wheat production in 1973-74 was based primarily on expansion of plantings in several major producing countries and an assumption of normal weather. Large increases were

forecast for the wheat crops in Australia, Canada and the U.S. Below normal moisture conditions were noted in Canada, China, North Africa and the Middle East.

However, by mid-1973, prospects had shifted again towards a tighter world wheat balance. While world production prospects improved slightly, increased consumption and expanded trade were forecast to result in another decline in stock levels. In its August 1973 assessment, USDA still forecast sharp increases in production for the U.S., USSR, Canada, and Australia. However, Argentine wheat was seriously hampered at planting time by wet weather, and Argentina was expected to harvest a crop one-fourth smaller than the year before. On balance, the rest of the world faced the prospect of small reductions in output.

This shift in outlook was associated with another round of rising prices, which began in July of 1973 and peaked at \$5.25 per bu. in February 1974. Even though world wheat production forecasts were revised upward again in October and December, export demand remained at a high level. Countries that had experienced reduced production earlier rebuilt stocks, and other countries made large purchases as protection against future shortages. It became apparent early in the 1973-74 marketing year that U.S. wheat stocks would be further depleted as a result of the strong export demand. (In fact, ending 1973-74 stocks reached 340 mil. bu., compared to 597 mil. bu. the year earlier and 983 mil. bu. at the end of 1971-72.)

Increased production of wheat and other grains in 1973-74 was not sufficient to compensate for the crop shortfall the year before and for

the expanded current season demand. Another factor, which exacerbated the grain situation, was the extremely tight supply-demand balance in the soybean complex which developed in 1973. Unanticipated purchases by the USSR and China, the failure of the Peruvian anchovy fishery in late 1972, and rising demand for high protein feed in livestock production resulted in unsustainable levels of demand and extremely high prices. Consequently, the U.S. was forced to take the unprecedented step of placing an embargo on soybean exports in June 1973. Two impacts were felt in the world grain markets. First, the high costs of protein feeds in livestock production increased demand for grains as an alternative source of protein. More importantly, the shock of the soybean embargo was to affect commodity markets for a number of years. The fear of shortages and possible future U.S. government restrictions on exports generated protective and speculative buying in excess of current needs.

1974

Two policy decisions were made in 1974. Both were a direct result of the instability in grain markets over the two past crop years. First, land previously withheld from grain production under government programs was allowed to come back into production for the 1974 crops. This action was aimed directly at expanding the supply of wheat and other grains.

A second policy effort was designed to improve the quantity and quality of information regarding the export demand for U.S. grains. By direction of Congress, USDA instituted an export sales reporting

system at the start of 1974. Although not fully implemented until later, the system allowed the government and the public to have more timely knowledge of U.S. grain purchases by foreign countries.

As the 1974 growing season throughout the Northern Hemisphere got underway in the spring, the initial projections (in March 1974) for 1974-75 production indicated sharp increases in world wheat and coarse grains. This was based on the large increase in planted acreage, particularly in the U.S., and it assumed normal yields. A decline in USSR wheat output was based on the assumption that two successive years of high yields was unlikely. Indian wheat production for 1974 was expected to be lower. On balance, most of the gain in wheat and coarse grain production was expected to occur in the U.S., with crops in the rest of the world showing small changes.

The expectation for a sharp expansion in production, marginal increases in trade, and a major replenishment of stock levels in 1974-75 was upset by the major weather-induced shocks to production which occurred later in the year.

The 1974 growing season was a disaster for U.S. grain production. The impact was greatest on spring sown crops, particularly corn and soybeans. Briefly, three events -- a cold wet spring, a hot dry summer, and a wet harvest -- combined to drastically reduce crop yields and production. Total wheat production actually expanded as a result of larger acreage, but spring wheat yields were sharply lower.

As these events developed in the U.S., declines in wheat production became apparent in the USSR, Canada, India, Argentina, and Australia.

Further, the Sahelian drought was in its sixth year. While the region and its population alone were not of sufficient size to greatly affect the world food balance, the growing global awareness of the suffering was an important contributing factor to the perception of the danger of a large-scale world food emergency in 1974.

As a consequence of all these factors, the world grain supply-demand outlook made another dramatic shift in the last half of 1974. This is illustrated by comparing USDA's assessments of the world grain balance in March and October of 1974. World wheat stocks had been forecast to rise by 11 mmt in March. By October, a decline of 7 mmt in 1974-75 ending wheat stocks was projected. For wheat and coarse grains, a 26 mmt increase in stocks expected in March had become a 21 mmt decline in October.

These significant events culminated in the World Food Conference in late 1974. Rapidly deteriorating U.S. domestic crops and prospects of real shortages of wheat, corn and soybeans during the 1974-75 season led to greatly increased market activity and heavy foreign purchases of U.S. commodities. Soviet re-entry into the U.S. grain market in the late summer and fall of 1974 raised serious concerns over the possibility of large purchases further tightening available supplies. This resulted in the negotiation of an agreement that would limit further purchases in 1974-75; and beginning in 1976-77, the U.S. and USSR put into effect a five-year agreement governing the level of grain trade between the two countries.

Globally, world grain production declined sharply from 1973. Wheat

production fell about 15 mmt and coarse grain production declined by 40 mmt. In the case of wheat, production estimates had been lowered throughout the growing season for several major producing countries -- Canada, Australia, the U.S. and the USSR. For the USSR, the final 1974 wheat production estimate was 16 mmt below the June projection and 11 mmt below the August estimate. Nearly all of the 40 mmt drop in world coarse grain production occurred in the U.S. (down 36 mmt).

As the 1974-75 marketing year progressed, wheat prices rose 36 percent from the seasonal harvest low to November of 1974. Following the conclusion of negotiations which produced the U.S./USSR Grains Agreement, prices stabilized, then declined throughout the remainder of the 1974-75 season. However, U.S. exports of grain remained at high levels. Ending 1974-75 stocks of U.S. wheat rose slightly, while coarse grain stocks reached record low level.

1975

By early 1975, adjustments to the reduced crop production in the last half of 1974 had become fairly evident. Initially, it had seemed that tight supplies and high prices would force sharp reductions in foreign demand. In fact, aggregate foreign consumption of grain, for both food and feed, had remained relatively stable. Most of the adjustment to reduced supplies and high prices had occurred within the U.S.

The first (in April 1975) USDA forecast for 1975-76 world grain production and consumption was in many respects similar to the initial 1974-75 forecast made a year earlier. Indicated planted acreage and assumed normal weather were expected to produce world wheat and coarse grain crops

almost equal to the level forecast in March of 1974. Similarly, identical forecasts were made for increases in ending stocks of 11 mmt and 25 mmt for wheat and coarse grains, respectively.

As the 1975 growing season progressed, generally favorable weather patterns prevailed. The U.S. produced its first wheat crop in excess of 2 billion bushels and a record corn crop. The favorable domestic wheat prospects resulted in U.S. farm prices reaching the lowest level in two years at harvest. However, by mid-1975, world wheat prospects began to seem less favorable. Estimates of the USSR wheat crop were reduced 5 mmt in July and again in August. With each reduction an equal quantity was added to projected Soviet wheat import requirements. Thus, during the late summer and fall of 1975, the world wheat balance again shifted from a position of production in excess of consumption to the prospect of production falling short of consumption.

USDA did not have an accurate estimate of USSR grain production until after October 1975. Declining Soviet production prospects were evident earlier, but the magnitude of the shortfall was greatly underestimated. The massive decline in USSR grain production amounted to 18 mmt of wheat and 34 mmt of coarse grains. To compensate for these losses, the USSR imported over 25 mmt of grain. The accompanying charts illustrate the behavior of U.S. wheat prices in relation to the pattern of purchases reported under the export sales reporting system.

1976

In April of 1976, USDA's assessment of upcoming world grain production prospects again was optimistic in terms of improved crop output

and recovery of stock levels. This time, events support this initial outlook. The high prices of the previous year had encouraged a large increase in global plantings and, barring severely adverse growing conditions, a major recovery was likely.

Crop prospects remained favorable as the season progressed, and as harvests in the Northern Hemisphere got underway the surplus wheat condition forecast earlier became more evident. By October of 1976, world wheat production was estimated to increase 44 mmt and stocks were estimated 29 mmt higher in 1976-77 than the year before. Even these estimates eventually turned out to be conservative. Wheat prices, which had been relatively stable in the first half of 1976, began to fall following the harvests and declined steadily throughout the remainder of the year and into the first half of 1977. Consequently, by end of 1976, it became evident that the recovery in wheat production and stocks had been so large that prices would remain stable at significantly reduced levels well into the next crop year unless production was reduced.

1977

In early 1977, wheat prices continued to decline as a result of large supplies and reduced export demand for U.S. grain, particularly by the USSR. It was apparent that wheat acreage would be reduced in 1977 in the Northern Hemisphere, especially in the U.S. and Canada. Southern Hemisphere plantings also were likely to decline later in the year. Signs of potential improvement in demand were evident from large Chinese purchases of Canadian, Australian and Argentine wheat for delivery

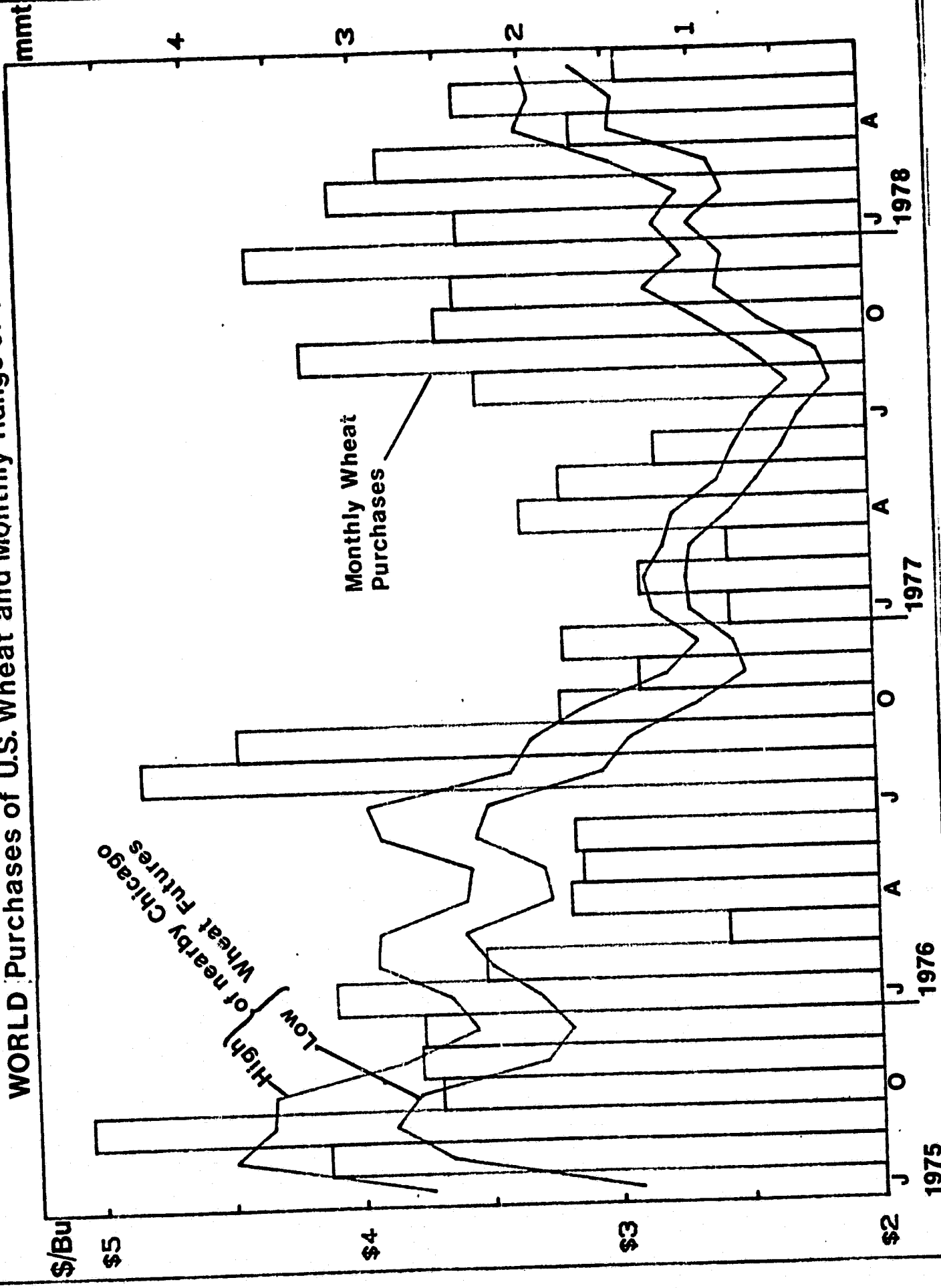
in Calendar 1977.

By the time the first forecast of the 1977-78 world wheat balance was made in May, evidence of reduced plantings and the likelihood of lower yields resulted in a moderate reduction in the wheat production projection. However, crop output was expected to exceed consumption requirements and raise stock levels. Production declines in China, Mexico and North Africa were expected to help improve the level of world trade.

At mid-year, world wheat production prospects still appeared quite favorable. The USSR was expected to harvest a record crop. This continual high production estimate was partially offset by increased projections for world consumption and expanded levels of imports by China. By August, small reductions in production brought projections equal to estimated consumption. Over the remainder of 1977, total wheat production estimates continued to decline, largely as a result of poor harvesting conditions in the USSR. At the same time, consumption levels remained high and export prospects continued to improve.

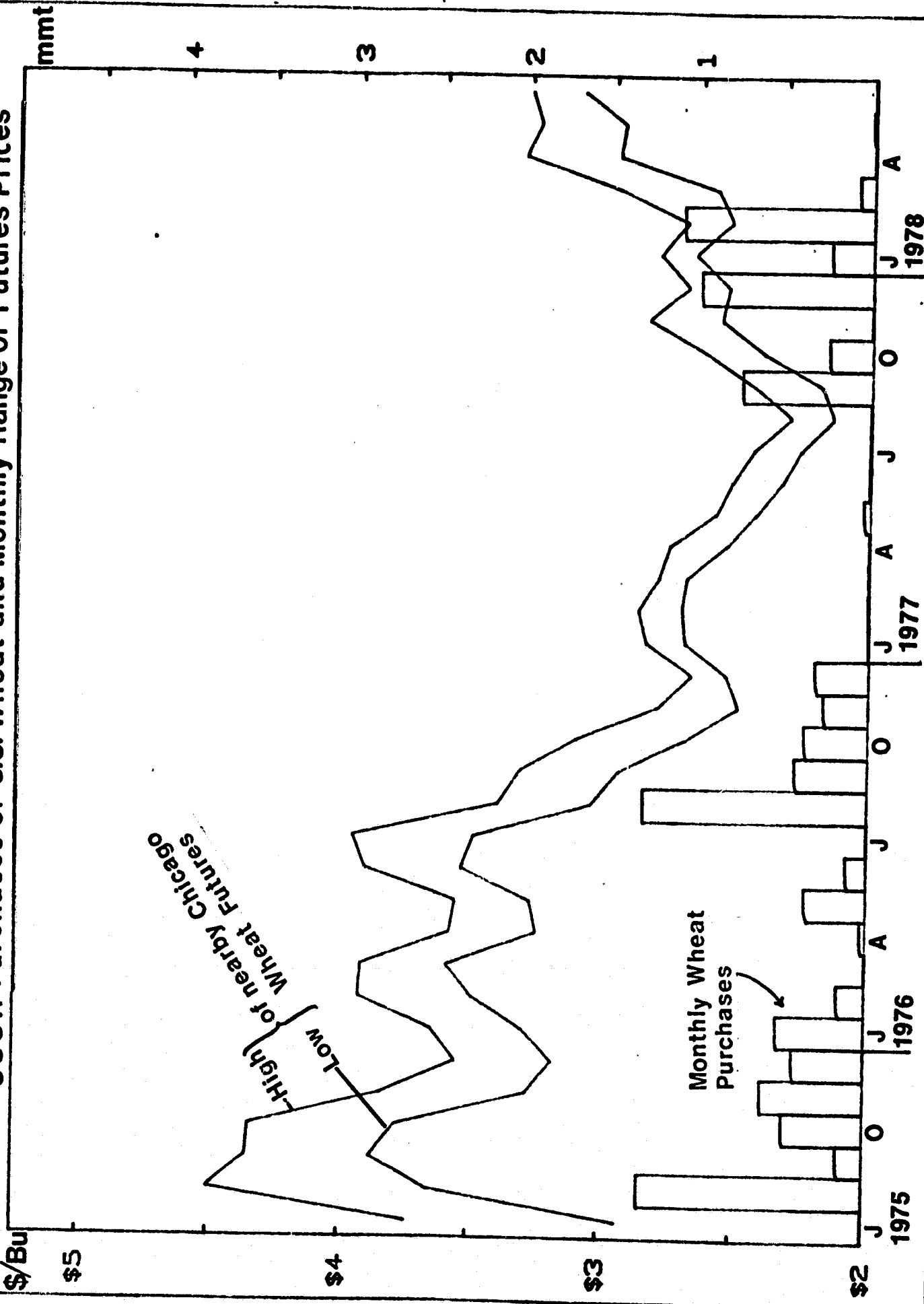
The expectation of significant reductions in stocks helped raise prices late in 1977. In the U.S., new legislation went into effect for the 1978 wheat crop. This resulted in acreage restrictions, and the prospect of a smaller 1978 crop also helped strengthen prices.

WORLD Purchases of U.S. Wheat and Monthly Range of Futures Prices

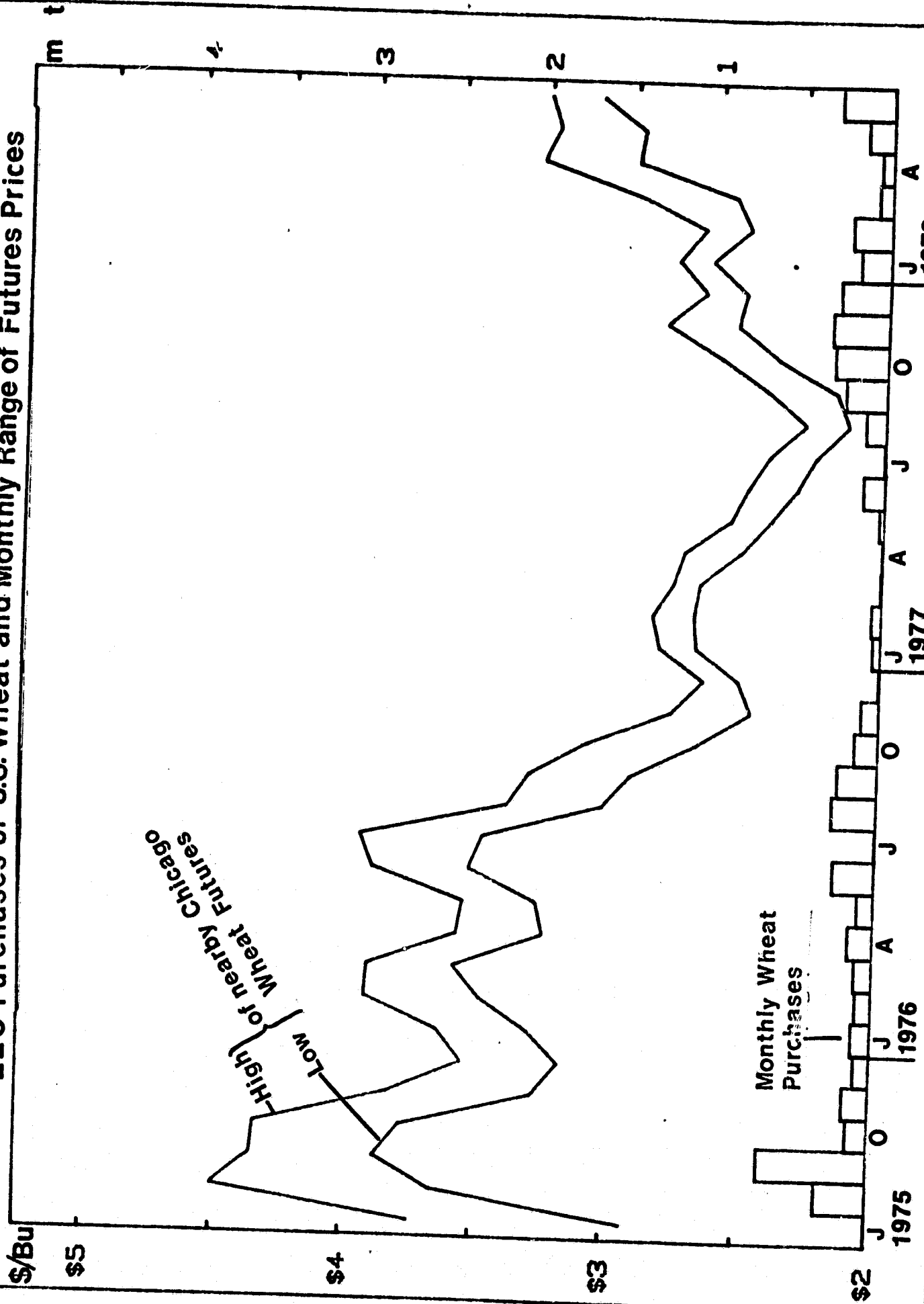


PART II

USSR Purchases of U.S. Wheat and Monthly Range of Futures Prices

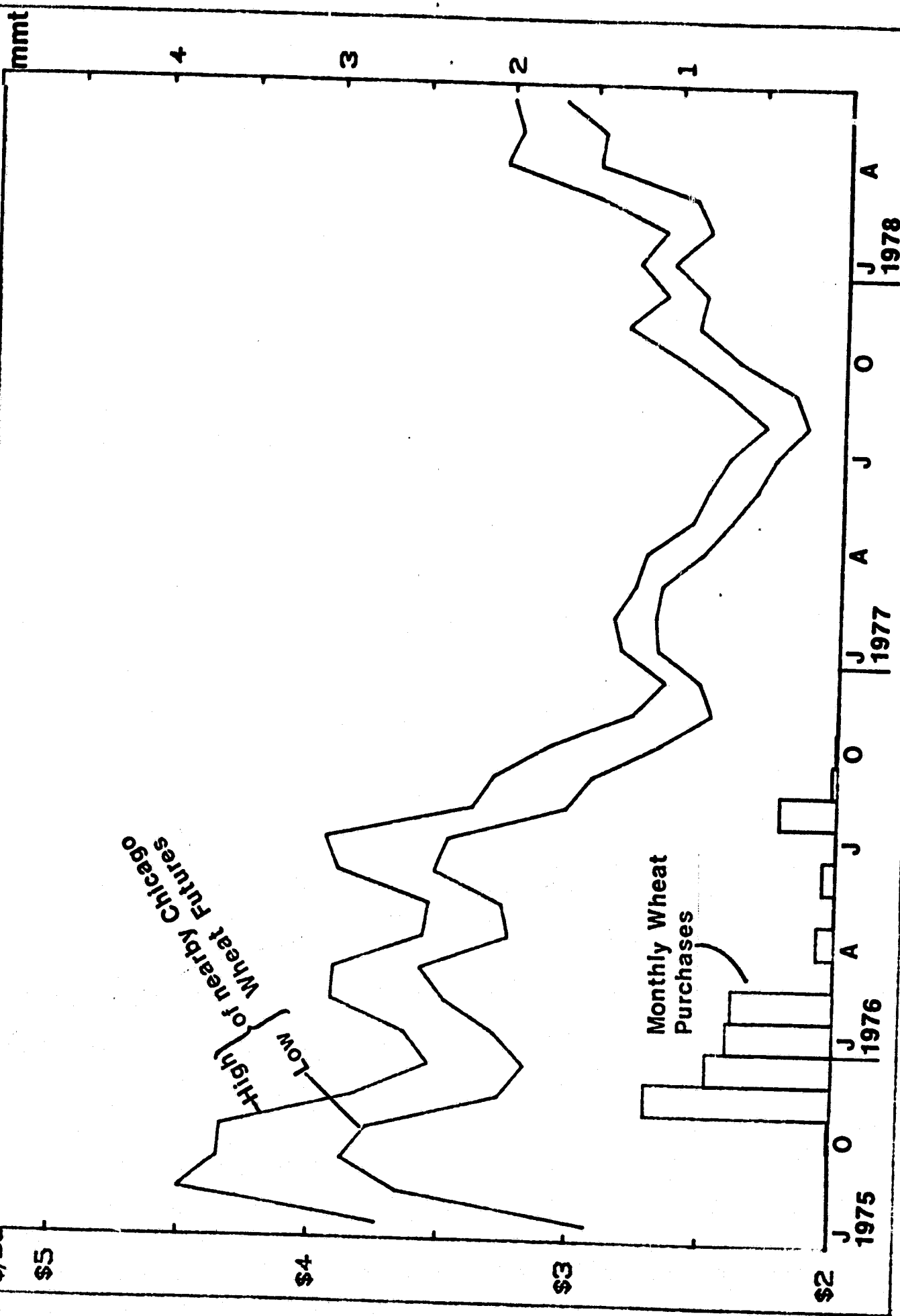


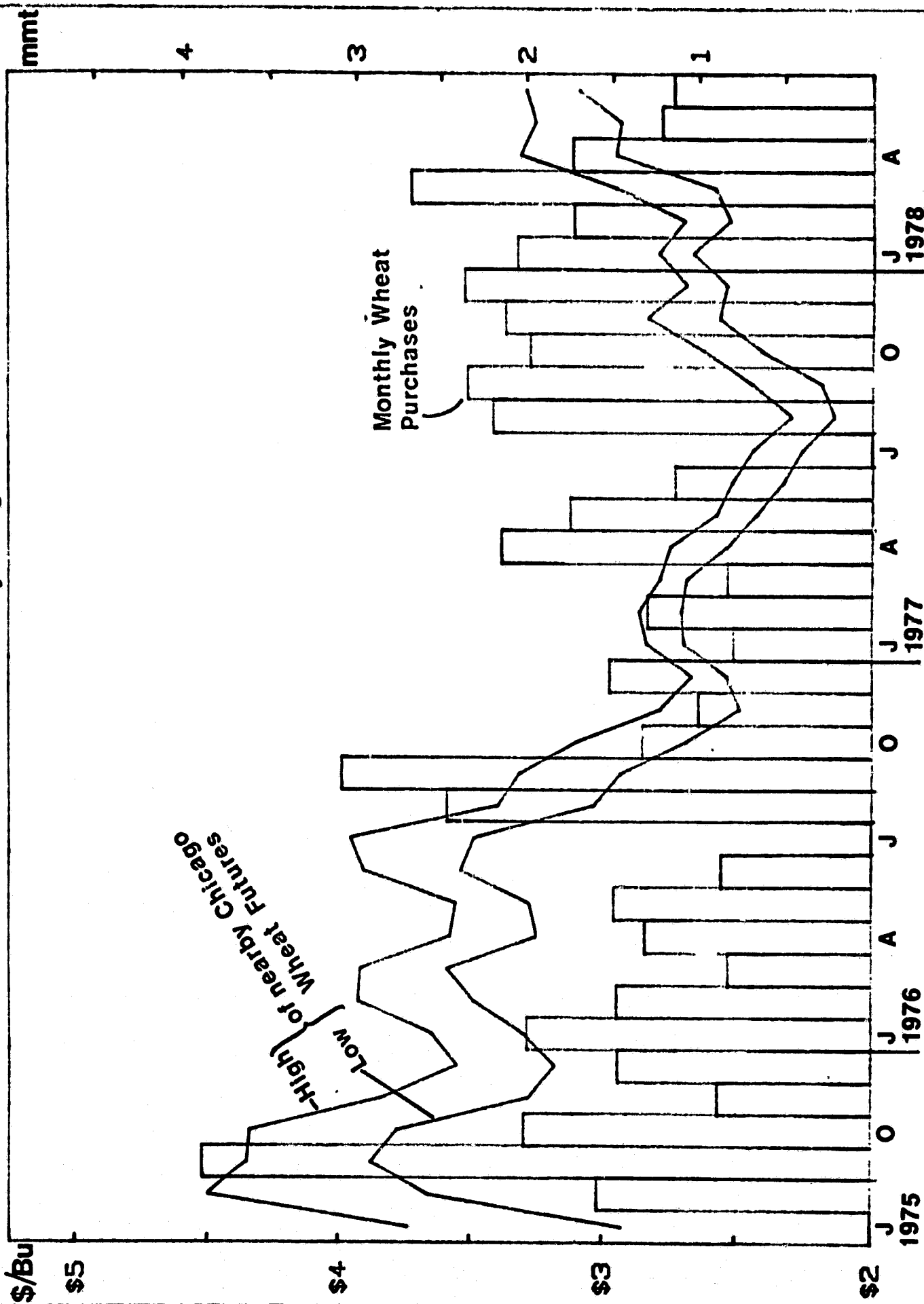
EEC Purchases of U.S. Wheat and Monthly Range of Futures Prices



Cl. IV

INDIA Purchases of U.S. Wheat and Monthly Range of Futures Prices





V. Influence of Better Production Estimates
on Market and Government Behavior

This section of the report examines how better estimates of world wheat production in the 1972-77 period could have affected the behavior of grain markets, the private grain trade, and the U.S. Government. As we saw in the previous section, the behavior of markets, trade, and government are interrelated because of the information available to each and the government's policy objectives. Between 1972 and 1977, these interrelationships led to USDA's decision to reduce acreage controls on grains in 1973 and to eliminate them completely in 1974; the establishment of the export reporting system; and the negotiation of U.S./USSR Grains Agreement. They also affected the behavior of markets and the grain trade.

In analyzing the impact of new information systems, we must assume that people who utilize the information believe that the new information system provides more reliable forecasts of production than alternative estimation procedures. It is not enough to assume one system is better than another; people have to believe it is. Furthermore, a given degree of improvement in production forecasting may have diverse effects on the behavior of different individuals or organizations. For example, a certain measure of improvement in the information system may be enough to influence government policy decisions, but not enough to alter the behavior of the grain trade.

A. Comparison of USDA and Hypothesized NASA Forecasts

USDA data on forecasts and final production of wheat for the U.S. and the rest of the world (ROW) for the crop years 1973-74 through 1977-78 are presented in Table 4. The forecast months are April, June, August, October, December, and February. Final production is based on data presented after February. These estimates are taken from various FAS Grain Circulars published regularly by the Foreign Agricultural Service of the U.S. Department of Agriculture.

USDA did not begin to publish monthly estimates of grain production in the ROW until 1973. For 1972, October was the first month for which estimates of ROW wheat production were published. Yet, the 1972-73 marketing year was a critical one; it was the first year the USSR made large grain purchases from the U.S. In subsequent analyses, we will make inferences about USDA production estimates from 1972-73 from the results obtained from the 1973-74 through 1977-78 period.

The reporting months in Table 4 are appropriate for Northern Hemisphere countries. For the Southern Hemisphere, where wheat is planted in the May-June period, the first relevant estimation month is probably August. Difference in growing seasons between hemispheres is discussed later.

USDA publishes production estimates separately for Canada, Australia, Argentina, W. Europe, the USSR, and the U.S. Estimates of U.S. wheat production are also issued by the Statistical Reporting Service of USDA. Production in other countries is aggregated into a total estimate. For

Table 4

U.S. and Rest of the World Wheat Forecasts, 1973-74 through 1977-78

		<u>April</u>	<u>June</u>	<u>mmt</u> <u>Aug.</u>	<u>Oct.</u>	<u>Dec.</u>	<u>Feb.</u>	<u>Final</u>
1973-74	Canada	18.0	-	17.0	17.0	17.1	17.1	16.2
	Australia	11.0	-	11.0	13.2	11.2	11.9	12.0
	Argentina	7.0	-	6.0	5.4	5.4	6.0	6.6
	W. Europe	49.0	-	50.0	49.8	50.2	50.5	50.8
	USSR	90.0	-	95.0	100.0	105.0	109.7	109.8
	Total ROW	298.0	-	301.0	307.8	311.3	320.4	325.9
	U.S.	48.0	47.0	46.7	47.0	46.6	46.4	46.4
	Total World	346.0	-	347.7	354.8	357.9	366.8	372.3
1974-75	Canada	19.4	16.5	16.2	13.4	14.2	14.2	13.3
	Australia	13.2	12.5	11.5	11.0	11.7	11.7	11.4
	Argentina	6.3	7.0	7.5	6.5	5.0	4.8	6.0
	W. Europe	52.5	53.2	52.8	55.3	55.6	55.9	56.7
	USSR	100.0	100.0	95.0	90.0	88.0	83.8	83.9
	Total ROW	318.8	317.6	310.4	303.2	301.2	297.1	308.6
	U.S.	56.4	56.9	50.1	48.5	48.8	48.8	48.9
	Total World	375.2	374.5	360.5	351.7	349.0	345.9	357.5
1975-76	Canada	17.0	16.6	16.3	17.0	17.0	17.1	17.1
	Australia	18.7	9.0	10.3	11.0	11.1	11.7	12.0
	Argentina	18.7	6.2	7.0	7.7	8.0	8.0	8.6
	W. Europe	53.1	51.5	49.9	49.0	48.6	48.5	48.5
	USSR	95.0	90.0	85.0	85.0	65.0	65.0	66.2
	Total ROW	317.0	304.4	299.9	300.9	284.0	283.1	292.3
	U.S.	57.8	59.5	58.3	58.7	58.1	58.1	58.1
	Total World	374.8	363.9	358.2	359.6	342.1	341.2	350.4
1976-77	Canada	18.1	18.1	20.0	23.6	23.5	23.5	23.6
	Australia	12.0	11.5	8.0	8.7	10.0	11.6	11.7
	Argentina	8.0	10.0	10.0	10.0	12.0	11.0	11.0
	W. Europe	55.8	52.3	50.5	50.2	50.5	50.6	50.7
	USSR	95.0	75.0	80.0	90.0	95.0	96.9	96.9
	Total ROW	330.4	318.0	320.8	334.7	345.1	348.3	356.8
	U.S.	54.4	53.0	55.0	57.9	58.4	58.4	58.4
	Total World	384.8	371.0	375.8	392.6	403.5	406.7	415.2
1977-78	Canada	16.3	16.8	16.0	18.4	19.7	19.7	19.8
	Australia	13.5	13.0	13.0	11.0	9.2	9.2	9.4
	Argentina	7.0	7.0	7.0	6.7	6.0	5.2	5.3
	W. Europe	54.3	52.4	51.3	50.4	47.9	47.8	47.7
	USSR	100.0	105.0	105.0	95.0	90.0	92.0	92.2
	Total ROW	343.5	347.8	342.0	330.7	324.5	325.8	326.4
	U.S.	53.5	55.1	55.5	55.2	55.1	55.1	55.1
	Total World	397.0	402.9	397.5	385.9	379.6	380.9	381.5

Source: World Grain Situation, Foreign Agricultural Circular
(Various Issues), U.S. Department of Agriculture.

countries other than the U.S., the individual countries for which estimates are reported account for about 60 percent of the ROW wheat production on average. The USSR alone, whose production is highly variable, accounted for an average of about 28 percent of ROW wheat production during the historical period under consideration.

We use the mean square error (MSE) adjusted for the number of observations as a measure of variation in monthly estimates about the final production estimate. The square root of the MSE $\sqrt{\text{MSE}}$ yields a measure of the standard error of the estimates, assuming there is no bias in the estimation procedures.

The $\sqrt{\text{MSE}}$ for each estimating month calculated from USDA's estimates are presented in column 1 of Table 5. As one would expect, errors in estimation decline as one moves closer to the final estimate. It should be noted that improvements in the accuracy of estimates is not achieved until after the April estimate for most Northern Hemisphere countries. For Argentina and Australia, estimation accuracy increases after August. For the Northern Hemisphere, where most of the world's wheat is produced, the August date is fairly far into the growing season.

An estimation interval corresponding to ± 2 standard errors ($4 \sqrt{\text{MSE}}$) is presented in column 2 of Table 5. This interval captures about 95 percent of the variation in the estimates.

To make these results comparable to the estimation procedure developed by ECON for NASA, we calculate the MSE measure based on normalized deviations for each year obtained by dividing each estimate by final production.^{1/} The normalization procedure adjusts the production

Table 5

Reliability of Wheat Production Forecasts Under the
Current Information System and Two Alternative NASA Methods

	<u>Current</u> <u>Information</u>		<u>6 Percent NASA</u>		<u>3 Percent NASA</u>	
	<u>√MSE</u>	<u>Interval</u>	<u>√MSE</u>	<u>Interval</u> mmt	<u>√MSE</u>	<u>Interval</u>
<u>Total Non U.S.</u>						
April	22.2	88.8	-	-	-	-
June	21.9	87.6	21.6	86.4	10.8	43.2
Aug.	19.9	79.6	19.3	77.2	9.7	38.8
Oct.	13.1	52.4	16.7	66.8	8.4	33.6
Dec.	9.7	38.8	13.7	54.8	6.8	27.2
Feb.	8.2	32.8	9.7	38.8	4.8	19.2
April	0	0	0	0	0	0
<u>Canada</u>						
April	4.5	18.0	-	-	-	-
June	3.3	13.2	1.2	4.8	0.60	2.4
Aug.	2.7	10.8	1.1	4.4	0.54	2.16
Oct.	0.70	2.8	0.94	3.76	0.47	1.88
Dec.	0.50	2.0	0.76	3.04	0.38	1.52
Feb.	0.50	2.0	0.54	2.16	0.27	1.08
April	0	0	0	0	0	0
<u>Argentina</u>						
June	1.7	6.8	-	-	-	-
Aug.	1.7	6.8	0.50	2.0	0.25	1.0
Oct.	1.3	5.2	0.45	1.8	0.23	0.92
Dec.	0.92	3.68	0.39	1.56	0.19	0.76
Feb.	0.63	2.52	0.32	1.28	0.16	0.64
April	0.20	0.80	0.23	0.92	0.11	0.44
June	0	0	0	0	0	0
<u>Australia</u>						
June	2.4	9.6	-	-	-	-
Aug.	2.8	11.2	0.76	3.04	0.38	1.52
Oct.	1.8	7.2	0.68	2.72	0.34	1.36
Dec.	0.99	3.96	0.59	2.36	0.29	1.16
Feb.	0.22	0.88	0.48	1.92	0.24	0.96
April	0.19	0.76	0.34	1.36	0.17	0.68
June	0	0	0	0	0	0

Reliability of Wheat Production Forecasts Under the
Current Information System and Two Alternative NASA Methods

	<u>Current</u> <u>Information</u>		<u>6 Percent NASA</u>		<u>3 Percent NASA</u>	
	<u>√MSE</u>	<u>Interval</u>	<u>√MSE</u>	<u>Interval</u> mnt	<u>√MSE</u>	<u>Interval</u>
<u>W. Europe</u>						
April	4.8	19.2				
June	3.4	13.6	3.4	13.6	1.7	6.8
Aug.	2.4	9.6	3.1	12.4	1.5	6.0
Oct.	1.5	6.0	2.6	10.4	1.3	5.2
Dec.	0.54	2.16	2.2	8.8	1.1	4.4
Feb.	0.35	1.4	1.5	6.0	0.76	3.04
April	0	0	0	0	0	0
<u>USSR</u>						
April	20.7	82.8	-	-	-	-
June	21.8	87.2	6.0	24.0	3.0	12.0
Aug.	12.7	50.8	4.7	21.6	2.7	10.8
Oct.	12.7	50.8	4.7	18.8	2.3	9.2
Dec.	3.0	12.0	3.8	15.2	1.9	7.6
Feb.	0.74	2.96	2.7	10.8	1.35	5.4
April	0	0	0	0	0	0
<u>U.S.</u>						
April	4.2	16.8	-	-	-	-
June	4.5	18.0	3.6	14.4	1.8	7.2
Aug.	1.3	5.2	3.2	12.8	1.6	6.4
Oct.	0.42	1.68	2.8	11.2	1.4	5.6
Dec.	0.11	0.44	2.3	9.2	1.1	4.4
Feb.	0	0	0	0	0	0
April	0	0	0	0	0	0
<u>Total World</u>						
April	23.3	93.2	-	-	-	-
June	25.3	101.2	25.2	100.8	12.6	50.4
Aug.	21.0	84.0	22.5	90.0	11.3	45.2
Oct.	13.3	53.2	19.5	78.0	9.8	39.2
Dec.	9.8	39.2	15.9	63.6	8.0	32.0
Feb.	8.2	32.8	11.3	45.2	5.6	22.4
April	0	0	0	0	0	0

data for long-run trends.

The remaining columns in Table 5 present the MSE for the NASA 6 percent and 3 percent estimation procedures. The 6 percent case corresponds to estimation accuracy of one standard error of ± 6 percent. This is equivalent to achieving the LACIE 90/90 goal of having an estimation procedure that is 90 percent accurate 90 percent of the time. According to this method, there are steady improvements in the accuracy of estimates over time. The 3 percent case corresponds to an alternative procedure assumed by NASA which is roughly twice as accurate as the 6 percent approach.^{2/}

As can be seen from Table 5, the NASA 6 percent case does not yield uniformly better estimates than the current USDA method based on normalized data. For total non-U.S. production, the estimates for June and August are slightly better using the NASA method, but those for subsequent months are not. However, the NASA 3 percent case results in estimates that are uniformly better than USDA's method by nearly 50 percent in many months.

The results presented so far for alternative estimation procedures for total ROW wheat production may differ from that obtained for individual countries. The USDA estimation procedure is based on a combination of crop estimation forecasts developed and made available by other countries and direct observations by USDA personnel and other people. Access to crop estimates or direct observations of conditions vary greatly among countries. Such information is good for major free world producing countries, especially in the larger developed countries. However, access

to information is very restricted in the Communist countries of Eastern Europe, the USSR and the PRC.

The NASA system, on the other hand, is based largely on satellite observations of relevant data influencing wheat production. Theoretically, such an approach should result in the same basic degree of forecasting accuracy for each country and is not heavily dependent upon the availability of national production estimates or the ability to personally observe crop conditions throughout the growing season.

The importance of this point is made clear by comparing the USDA and proposed NASA estimation procedures for specific countries.

- Canada: NASA 6 percent is better than the USDA current system early in the crop year, but is less accurate after August.
- Argentina: NASA 6 percent is uniformly better than USDA estimates starting in August.
- Australia: NASA 6 percent is better than USDA through December, but less accurate thereafter.
- W. Europe: USDA estimates are more accurate than NASA 6 percent after June.
- USSR: NASA 6 percent method is much superior to USDA through October.
- U.S.: After June, USDA estimates are superior to those from NASA 6 percent.

The estimation errors for the USSR in the current system dominates those for ROW. The $\sqrt{\text{MSE}}$ for the USSR is nearly equal to that for all of the ROW. Justification for the NASA estimation system may turn out

to be based heavily on its performance for the USSR and other centrally planned countries where information based on direct observation of crop conditions is scanty.

B. Price Behavior with More Accurate
Wheat Production Estimates

Any analysis of the effect of more accurate world wheat production estimates on prices must take into account the extent to which improved information is used by the various groups whose response directly or indirectly influences market prices. In this context, direct market participants include producers, processors, exporters and speculators; the major indirect participant with a significant influence on market price behavior is the government.

For direct market participants, the dissemination of improved information should tend to equalize the level of that information among various groups. That is, a larger number of producers would have greater access to improved information, even though it may not be used efficiently. It is assumed that the relative increase in information available to producers is greater than the incremental increase to other market participants, who previously had formalized information systems. This should allow a more balanced (but possibly still unequal) level of information for groups participating in world grain markets.

For governments, the impact of improved information on world wheat production estimates is dependent upon policy changes with respect to production and trade. Two policy decisions were extremely important

at the start of the 1972-77 period. One was the decision of the USSR to adjust to its crop shortfall by importing substantial quantities of grain rather than reducing domestic consumption. As noted previously, there were early indications of policy changes which implied the potential for increased trade. However, it is still questionable whether better estimates of USSR wheat (and coarse grain) production in 1972 would have resulted in an accurate forecast of grain imports.

The other policy variable was U.S. production controls. Late in 1972, the USDA relaxed, but did not completely remove, acreage restrictions for 1973 crops. Had more accurate estimates of world wheat production and trade been available, it is possible that production controls would have been completely removed for the 1973 U.S. crop. This could have resulted in an expansion of 15 million acres in wheat plantings instead of the 5 million acre increase actually planted.

For purposes of this study, it is assumed that the estimate of a Soviet grain production shortfall and a relatively accurate forecast of the substantial increase in grain imports would have been predicted as early as June 1972 and that the U.S. would have completely abandoned supply control measures for crops to be harvested in 1973. These two factors -- a timely accurate assessment of the world grain balance and a policy initiative to remove acreage controls -- would probably have had a major impact on world wheat markets. In terms of the extent of use of improved global wheat production information by the U.S. government, these actions would represent the maximum level of utilization.

The actual supply and utilization for wheat in the 1972-73 through 1977-78 period are presented in Table 6. Revised estimates based on improved information are given in Table 7. Monthly and season average prices corresponding to these two alternatives are shown in Table 8.

Both the historical data and the improved information scenario for wheat reflect the substitution of wheat and coarse grains in production and consumption. In many major producing areas, wheat and coarse grains can be grown on the same land, and the relative importance of each depends upon their relative prices. Further, wheat is used as a feed grain, especially in Europe and the USSR. In many developing countries, coarse grains are used directly for food and can substitute for wheat. The data presented for wheat include the effects on wheat consumption and prices of changes in the coarse grain supply-demand situation in each year.

The immediate impact of improved information on wheat production would have been to raise U.S. wheat prices during the 1972 winter wheat harvest. Such a development would have led to a more even distribution of prices during the 1972-73 marketing year. Under these conditions, an important source of political criticism of the USSR wheat sales would have been blunted, i.e., from farmers who sold their wheat early in 1972-73 at season-low prices and before the full extent of Soviet grain purchases were known. The USDA is an important source of marketing information and advice to farmers. Had improved estimates of wheat production been available and allowed a more accurate assessment of the world supply-demand balance, the information disseminated by the various USDA

Table 6

<u>U.S. Wheat Supply-Demand Balances</u>						
	<u>1972-73</u>	<u>1973-74</u>	<u>1974-75</u>	<u>1975-76</u>	<u>1976-77</u>	<u>1977-78</u>
Planted Acreage (Mil)	54.9	59.3	71.0	74.8	80.2	75.1
Harvested Acreage (Mil)	47.3	54.1	65.4	69.4	70.8	66.5
Yield (Bu/Acre)	32.7	31.6	27.3	30.6	30.3	30.6
- - - - - million bushels - - - - -						
Beginning Stocks	983	597	340	435	665	1,112
Production	1,546	1,711	1,782	2,122	2,142	2,036
Imports	1	3	3	2	3	2
Total Supply	2,531	2,311	2,125	2,560	2,810	3,150
Feed/Other	201	128	39	35	68	183
Food	530	542	541	588	588	586
Seed	67	84	92	99	92	80
Total Domestic	799	754	672	722	748	849
Exports	1,135	1,217	1,019	1,173	950	1,124
Total Disappearance	1,934	1,971	1,690	1,895	1,698	1,973
Ending Stocks	597	340	435	665	1,112	1,177

Table 7

Estimated U.S. Wheat Supply-Demand Balances With Improved Information

	<u>1972-73</u>	<u>1973-74</u>	<u>1974-75</u>	<u>1975-76</u>	<u>1976-77</u>	<u>1977-78</u>
Planted Acreage (Mil Acs)	54.9	70.0	71.0	74.8	80.2	74.8
Harvested Acreage (Mil Acs)	47.3	64.0	65.4	69.4	70.8	66.2
Yield (Bu/Acre)	32.7	31.5	27.3	30.6	30.3	30.6
- - - - - million bushels - - - - -						
Beginning Stocks	983	651	695	500	730	1,152
Production	1,546	2,018	1,782	2,122	2,142	2,026
Imports	1	3	3	2	3	2
Total Supply	2,530	2,672	2,480	2,624	2,875	3,180
Feed/Other	147	139	60	63	125	191
Food	530	531	540	559	560	569
Seed	67	90	92	99	88	80
Total Domestic	744	760	692	721	773	840
Exports	1,135	1,217	1,288	1,173	950	1,124
Total Disappearance	1,879	1,977	1,980	1,894	1,723	1,964
Ending Stocks	651	695	500	730	1,152	1,201

Table 8

**U.S. Wheat Prices Received by Farmers;
Actual and Estimated with Improved Information**

	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>Season Average</u>
	- - - - - (dollars per bushel) - - - - -												
<u>1972-73</u>													
Actual	1.33	1.32	1.51	1.73	1.89	1.97	2.38	2.38	1.97	2.06	2.15	2.15	1.76
Estimated	1.45	1.70	1.90	2.00	2.10	2.20	2.35	2.35	2.25	2.20	2.15	2.15	1.97
<u>1973-74</u>													
Actual	2.43	2.47	4.45	4.62	4.22	4.20	4.78	5.29	5.52	4.96	3.98	3.52	3.95
Estimated	2.43	2.47	2.70	2.90	3.10	3.30	3.50	3.70	3.90	3.80	3.60	3.52	3.00
<u>1974-75</u>													
Actual	3.57	4.04	4.24	4.32	4.85	4.87	4.65	4.11	3.95	3.65	3.69	3.47	4.09
Estimated	3.57	4.04	4.24	4.32	4.40	4.40	4.35	4.10	3.85	3.55	3.50	3.40	4.01
<u>1975-76</u>													
Actual	2.92	3.33	3.89	4.11	4.02	3.58	3.41	3.43	3.66	3.65	3.50	3.43	3.56
Estimated	2.92	3.40	3.89	4.11	4.02	3.58	3.41	3.43	3.66	3.50	3.35	3.20	3.55
<u>1976-77</u>													
Actual	3.46	3.33	2.97	2.88	2.59	2.46	2.39	2.43	2.47	2.43	2.37	2.19	2.73
Estimated	3.00	2.90	2.60	2.30	2.30	2.35	2.35	2.40	2.40	2.35	2.25	2.15	2.52
<u>1977-78</u>													
Actual	2.03	2.04	2.13	2.16	2.30	2.46	2.47	2.53	2.59	2.67	2.82	2.82	2.31
Estimated	2.03	2.04	2.13	2.30	2.45	2.46	2.47	2.53	2.59	2.67	2.82	2.82	2.35

services would have been considerably different. Similarly, other information sources important to farmers, such as farm publications and other media services, very likely would have counseled against early marketing of crops following the harvest.

Since feed use of wheat is a significant source of wheat disappearance when prices are low, particularly early in the marketing year, higher

wheat prices would have reduced the amount of wheat fed by an estimated 54 mil. bu. in 1972-73. Assuming exports and domestic food use unchanged, ending stocks for the 1972-73 season would have been 54 mil. bu. larger. As a result, an earlier rise in prices would have reduced total demand and moderated the sharp decline in ending stocks. The season average price received by farmers (weighted by marketings) would have been higher -- \$1.97 per bu. compared with the actual average price of \$1.76 per bu.

The decline in wheat prices during the spring of 1973 was associated with an early (April) USDA forecast of increased world wheat production for the 1973-74 season. This was based on indications of larger planted area and normal yields. By mid-1973, there were indications that production increases would be more moderate. However, in August USDA was still forecasting large increases in wheat output for the major producing countries. In fact, USDA's estimates of world wheat production continued to rise throughout the 1973-74 crop year.

During this period, in spite of larger production, export demand tended to be underestimated. This was due partly to a desire by countries to rebuild depleted stocks and partly to speculative buying associated with a general rise in commodity prices. As a result, farm level wheat prices rose from \$2.15 per bu. in May 1973 to a high of \$5.29 per bu. in January 1974.

Had USDA's early season estimates of world wheat production been closer to the actual final estimate, it probably would have dampened some of the speculative demand, but it might not have had a significant impact on import demand generated by stock replenishment. USDA's final estimate of world wheat production in 1973-74 was 25 mmt above its August

estimate.

What would have made a great impact, however, was the large increase in U.S. wheat production that would have resulted from a complete abandonment of acreage control programs. As discussed above, this action would have been a direct result of a more timely and accurate assessment of the 1972-73 supply-demand balance. It is estimated that farm prices would have averaged approximately \$3.00 per bu. instead of \$3.95 per bu. The seasonal price changes also would have been less extreme than those that actually occurred.

As discussed in Section IV, 1974 was a disastrous year for both wheat and feed grain production. Because of the substitution effect between wheat and feed grains, very high coarse grain prices helped support the price of wheat.

USDA forecasts of world wheat production declined by nearly 25 mmt between the April and June estimates and the December assessment. Upward revisions of production in Southern Hemisphere and some developing countries placed the final estimate of 1974-75 production at 8 mmt above the December 1974 estimate.

The effect of an improved information system during the 1974-75 season probably would have been limited to a slight lowering of average prices and a less pronounced seasonal rise. These small differences in prices would have resulted from:

- Larger supplies at the start of 1974-75 (increased stocks carried over from the previous season); and
- More timely estimates of the deterioration in world wheat and feed grain crop conditions.

Wheat production in the USSR was overestimated by 10 mmt in August 1974. A more accurate estimate probably would have given a strong indication of larger wheat (and feed grain) imports. Increased supplies of wheat in 1974-75 could have permitted additional U.S. wheat exports of about 270 mil. bu. This larger exportable supply would have moderated, to some degree, the rise in wheat and feed grain prices and probably permitted a slightly larger wheat carryover at the end of the year. Prices during the 1974-75 season probably would have averaged about \$.08 per bu. lower (two percent). Also, the season high prices during October-November 1974, probably would have been lowered by approximately \$.45 per bu.

In the 1975-76 season, USDA's August estimate of global wheat production was only 8 mmt above the final outcome. However, estimating accuracy varied widely among countries. The early projections of the USSR wheat and feed grain crops turned out to be disastrously low. As late as October 1975, the USDA was still estimating Soviet wheat production at 85 mmt, about 20 mmt above actual production. At the same time, wheat production in many other countries was significantly understated.

The sharp drop in Soviet grain production was known or suspected by many grain trade sources during the growing season. The implied sizeable grain import requirements led to a sharp rise in wheat prices during the July-September 1975 period. USDA's ultimate revision of USSR grain production (in November 1975) merely confirmed the private assessment made several months earlier.

Under these circumstances, it is doubtful that an improved crop estimation system would have provided significantly more information to the wheat market that was already available, although it would have enhanced USDA's early season assessments. As a result, the behavior of wheat prices under an improved information system would not have been much different from the historical experience. More accurate USDA estimates of the Soviet grain situation probably would have resulted in prices rising somewhat faster during the summer of 1975. Larger stocks of wheat at the start of the 1975-76 season would not have been sufficient to moderate prices significantly.

Throughout the 1976-77 season, USDA consistently underestimated the size of world wheat production. The August 1976 estimate for world production was 40 mmt too low, including a 17 mmt underestimate of USSR production. Based on these assessments, market prices declined throughout the year. The early forecasts of a more moderate increase in production, followed by continuous upward revisions in world supplies, resulted in the unusual pattern of wheat prices at yearly highs during harvest and declining steadily over the remainder of the season.

More timely and accurate estimates of world wheat production would have led to a more rapid decline in wheat prices during the summer of 1976. Prices generally would have averaged lower throughout the 1976-77 marketing year, probably by about 8 percent. Higher domestic use of wheat for feeding would have occurred as a result of lower prices. It is doubtful that more precise estimates of the 1976-77 world wheat balance would have altered USDA's decision to reduce wheat production in

1977 through the acreage set-aside program.

The main source of estimation error in 1977-78 again was crop production in the USSR. As late as August 1977, USDA was estimating a Soviet wheat crop of 105 mmt, or 13 mmt above the actual production level. It is possible that a satellite estimation system may not have improved the production assessment, since most of the crop shortfall occurred as a result of unfavorable weather at harvest time. However, if a significant part of the deterioration in Soviet wheat production could have been forecast by late August, it would have affected the seasonal price behavior. But the fundamental supply-demand balance for the 1977-78 season would not have been altered, since wheat supplies were adequate to meet domestic and export demand.

Season average wheat prices would have been only a few cents per bu. higher under an improved information system, primarily as a result of a somewhat more rapid rise in prices during the fall of 1977. Wheat prices remained high at the end of the 1977-78 season. Prices were supported by a continuation of the acreage set-aside program for the following year and by the establishment of a grain reserve, which insulated wheat supplies from the market. These program decisions, applicable for the 1978 wheat crop, would not likely have been greatly affected by more timely and accurate assessments of the previous year's production.

Footnote

^{1/} Economic Benefits of Improved Information on Worldwide Crop Production, ECON, Princeton, N.J., November 15, 1976, pp. 8-14.

VI. Benefits and Losses from Improved Information

The impact of improved information on world wheat production could occur from two interrelated sources. First, to the extent that more accurate and timely estimates of wheat production improves the assessment of the global supply-demand balance and this information is widely disseminated, market price determination should be enhanced. That is, when participants on each side of the market -- buyers and sellers -- have access to accurate supply information, prices at which commodities trade should more accurately reflect the underlying supply-demand balance. And second, the improved information allows positive adjustments to be made in supplies. This results when governments take policy actions based on improved information. During the 1972-77 period, the major USDA policy response would have been an earlier removal of acreage restrictions.

As discussed in Section V, market price behaviors would have been altered with improved information. Except for the 1972-73 and the 1977-78 wheat marketing years, average prices received by farmers would have been lower. Within each year, wide swings in prices would have been moderated. The altered price behavior would have constituted one source of the economic impact to producers. Another would have been adjustments in the volume of wheat marketed. It is estimated that, under an improved information system, wheat markets would have increased in two of the six crop years considered. Three years would have shown no significant change. And in one year (1972-73), marketings would have been reduced.

A. Producer Benefits

Available data on seasonal marketing patterns by farmers indicate that these patterns have changed. Wheat farmers still sell the bulk of their production in the first three months of the season; however, the trend is toward more balanced marketings throughout the year. It has been assumed that a new information system would not have significantly accelerated this trend. Therefore, no attempt was made to adjust seasonal marketing patterns when calculating alternative levels of returns to producers.

The procedure used to compare the returns to wheat producers under an improved information system with the actual conditions during 1972-77 was based upon the total quantity of wheat disappearance in each market year. Total disappearance was weighted by monthly farmer marketings and multiplied by the alternative monthly average prices. These values were added to arrive at total returns for each year. A simpler, but less accurate, comparison would have been made by estimating the value of production only. However, this would have ignored the effects of changes in stock levels that occurred during the period. While the method used does not precisely calculate farm receipts, the principal objective was to compare the difference in returns to farmers from an improved information system. It was believed that the technique used would closely approximate the alternative levels of returns.

Producer returns in 1972-73 would have increased under the improved system by about \$300 million (Table 9). This would have been the result of a more rapid rise in prices during the early part of the season

when marketings were heaviest. This would have offset a small reduction in demand. In 1973-74, the improved information would likely have generated returns about \$1.18 billion lower. This also would have been a price effect, since marketings would have been unchanged. The improved information would have led to an abandonment of set-aside programs and moderated the sharp rise in prices during the fall and winter of 1973-74.

The greatest benefits to farmers would have occurred during the 1974-75 marketing year, when producer returns would have been \$950 mil. greater. The impact of improved information on prices would have had only a marginal moderating effect. However, had the improved information system been in effect since 1972, the acreage production and stock adjustments that would have occurred prior to 1974-75 would have allowed a greater supply available to meet the global grain shortage.

In the following year, the improved system would have had a small negative impact on producers' returns, due to slightly lower prices late in the 1975-76 season when farmer marketings are small. With the bumper global wheat crop in 1976-77, improved information would have resulted in significantly lower average prices with only a marginal rise in demand. Producer returns would have been \$400 million lower. For the 1977-78 season, the principal effect would have been a somewhat stronger post-harvest price rise in the fall. This would have increased producer returns by about \$40 million.

Table 9

<u>Alternative Returns to U.S. Wheat Producers Under the Prevailing and Improved Information Systems</u>			
<u>Marketing Year</u>	<u>Systems</u>		<u>Change</u>
	<u>Prevailing System</u>	<u>Improved System</u>	
	-----million dollars-----		
1972-73	3,408	3,703	+295
1973-74	7,760	5,934	-1,826
1974-75	6,995	7,949	+954
1975-76	6,770	6,729	-41
1976-77	4,736	4,347	-389
1977-78	4,589	4,632	+43
Total	34,258	33,294	-964

B. Consumer Benefits

The major benefit to U.S. consumers would have been lower and more stable prices for bread, flour, and other wheat products. However, since less than one-third of U.S. wheat production is consumed domestically as food, the direct benefits due to lower food prices would have been small. (Had the improved information system been evaluated for feed grains as well as wheat, it would show a much larger benefit to consumers in the form of lower food prices and expenditures. This is because feed grain prices would also have been lower on average, and production larger, due to earlier cancellation of set-aside programs. This in turn would have resulted in larger production of and lower prices for livestock, poultry, and dairy.)

Assuming that the estimated changes in farm prices were passed directly through to consumers, the only significant differences in

aggregate food costs would have occurred in 1972-73, 1973-74, and 1976-77. The cost of wheat products would have been \$110 million higher in 1973-74, but this would have been more than offset by reductions of \$500 million and \$100 million in 1972-73 and 1976-77, respectively.

In terms of the costs of specific food items, the price impact would be imperceptible. For example, in the year of the greatest impact on wheat prices, 1973-74, the reduction in cost of a 10-lb. bag of flour would have been only 22 cents. The reduction in the cost of a loaf of bread (one lb.) would have been 1.4 cents.

These estimates assume no changes in marketing and processing margins under the improved information system. A case might be made that the greater stability in wheat prices could have slowed the rise in margins. (For example, flour milling margins doubled during 1972-73.) However, since the period also experienced inflationary pressures from rising energy costs and instability in other ingredient prices such as shortening and sugar, it is likely that any impact on marketing and processing margins would have been negligible.

C. Exports

A greater impact would have occurred in the value of U.S wheat exports under the improved information system (Table 10). In each year except 1974-75, the changes would have occurred as a result of prices, because quantities exported, except in 1974-75, would have been unchanged.

Table 10

<u>Changes in the Export Value of U.S. Wheat Under the Improved Information System</u>	
<u>Marketing Year</u>	<u>(Million Dollars)</u>
1972-73	+193
1973-74	-1,168
1974-75	+942
1975-76	-47
1976-77	-199
1977-78	+23
Total	-256

Export value estimates were based on estimated changes in farm level prices. Since the volume of grain shipped would have been the same in each year, export basis prices can be assumed unchanged. However, since seasonal export patterns differ from farmer marketing patterns, simple average prices were used instead of weighted average prices.

The higher price rise early in the 1972-73 season under the improved information system would have increased export earnings during this year. The improved system, if it had been in effect, would very likely have led to an earlier elimination of the wheat export subsidies in effect then. This would have lowered government costs and reduced exporter revenues during the season. In 1973-74, the lower (and more stable) prices would have resulted in sharply lower export revenues. That would have been partially offset the following year, when the higher export volume would have accounted for larger export earnings. In the 1975-76 and 1977-78 seasons, the improved system

would have resulted in only marginal changes in export earnings. However, in 1976-77 export earnings would have been reduced even further under the improved system.

It is difficult to assess the impact of the improved wheat production estimating system on grain exporting firms because information on their actual operations during the 1972-73 through 1977-78 period are not available.

To the extent that some of these firms had more accurate information on world wheat production and trade than was available to the market generally, they were in a position to make large profits. However, they also faced substantial market risk due to the extremely volatile prices during the period examined. The costs incurred for grain exporting firms in dealing with volatile prices may, in some years, have been equal to or greater than the advantages gained from timely information.

The improved information system analyzed in this report would probably reduce any information advantage grain exporting firms have over the rest of the market and, thus, the potential profits derived from such an advantage. At the same time, prices would have been less volatile and market risks lower. Thus, it is not clear what the net effect of the better information system would have been on the profits of grain exporters.

VII. Policy Implications for the U.S.

A crop estimation system based on satellite technology could improve the functioning of U.S. and world grain markets and U.S. policy formulation and implementation. Although a reliable production estimation system provides only half of the necessary information to assess the global supply-demand balance, it is the first and, in most instances, the most important step.

From the U.S. perspective as the major producer/exporter and as the country which provides the major adjustments in stocks in times of imbalance, timely accurate estimates of global grain supplies would allow improved assessments of the supply-demand balance and enhance the policy formulation ability of the U.S. government. These improvements are discussed below.

A. Improved Estimation of Export Demand

The new crop estimation system would lead to a substantial improvement in production estimates for the centrally planned countries. These nations are major grain producers and importers, and the USSR is a major source of instability in world grain production. More timely and accurate estimates of wheat (grain) production for that country alone would lead to improved demand projections and to more stable behavior of markets if this information were generally available.

Currently, the U.S. relies heavily on the five-year (U.S./USSR) Grains Agreement, now in its third year, to stabilize grain trade between the two countries. The USSR is required to buy at least 6 mmt of grain per year (equally divided between wheat and feed grains) and can buy 8 mmt without prior consultation. The Soviets may buy more, depending on U.S. grain

supplies and approval by the U.S. government. During 1977-78 and 1978-79, the USSR has been allowed to buy up to 15 mmt of grain because U.S. and world supplies were adequate.

Typically, the upper limit of purchases allowed by the U.S. has not been determined before October, when U.S. supplies are known with a high degree of certainty and a reasonably good estimate of USSR production is available. Even so, the actual level of USSR grain purchases for the coming year remains uncertain. Since the October date is more than one-quarter of the way through the U.S. wheat marketing year, the present arrangement still leaves a great deal of uncertainty about USSR grain needs during a period when farmers market a substantial portion of their production and are making critical decisions concerning the next year's crop. A more accurate estimate of USSR and other countries' wheat production by the beginning of August would improve the market price determination process and improve allocation of supplies through the marketing year. Also, as outlined below, it would enhance farmers's decisions about the next crop.

B. Production and Price Policies

USDA must make a decision on set-aside programs for wheat by early August to guide farmers' winter wheat planting decisions. (A similar decision for feed grains is made in early November.) This program determination is made before firm estimates of world wheat production are available, particularly for the USSR and Eastern Europe among the Northern Hemisphere countries. If USDA had more accurate estimates of the world wheat situation before it had to make acreage set-aside decisions for

wheat, it would reduce the risk of making a wrong decision -- either allowing for too little U.S. production in the year after a poor world wheat crop or too much U.S. production after a year of large world crop production.

The U.S. has established a farmer-owned, long-term grain reserve as a way to help stabilize U.S. and world grain prices. There are now slightly over 400 mil. bu. of wheat, about 730 mil. bu. of corn, and nearly 125 mil. bu. of other feed grains in this reserve. Farmers are paid to hold reserves, but they become available to the market when prices reach specified levels. Market prices are determined by a combination of production, demand, and government program decisions. Better production estimates could lead to improved management of the long-term grain reserves. Anticipation of poor world grain crops would help ensure a relaxation of set-aside programs for the coming year. If reserves were reduced in the current year as a result of poor crops, larger production in the following year would help ensure adequate supplies to rebuild reserves. Thus, improved estimation of world grain production could help guarantee that reserves are not depleted. This is especially important for wheat, as discussed above, since U.S. production decisions for next year must be made before the size of the current year's level of world wheat production may be known with a high degree of certainty.

Also, it is costly to hold large grain reserves. The determination of their size has been based in part by existing crop estimation procedures. It is possible that improvements in estimation procedures could reduce the size and, therefore, the costs of required reserves.

C. Policies to Improve Information

This report assumes that better wheat production estimates via a satellite system would be publicly available. All countries would benefit from the estimates, including both those who have but do not share information about their crop conditions and those who do not have timely production estimates. Demonstrating the value of better production estimates could have two salutary effects. It might encourage centrally planned countries to share information on their own crops on a more timely basis. Any advantage they currently gain from not sharing this information would be eroded with a reliable system based on satellite estimations; therefore, these nations would have less reason for not making public estimates of their own crop sizes. The availability of ground-based estimates as a supplement to satellite estimates would probably improve the overall estimation procedure.

And second, countries that currently have poor crop estimation procedures might be induced to improve them if they realize the benefits of better estimates. Information available to them from satellite technology would supplement ground-based estimation procedures, and it might require less of an investment in the latter than would be required without a satellite component.

D. Structure of the Grain Trade

We argued earlier in this report that the concentration of firms in international grain trade grows out of the economies of scale in information. It follows, therefore, that better information about world production, publicly available, would reduce the advantages of scale economies that now

accrue to a few firms and that a larger number of firms would participate in the international grain trade.

It was also argued earlier that grain markets are generally competitive, even though international grain trade is dominated by a few large firms. There is no guarantee, however, that the competitive character of grain markets would be maintained if there were further concentration in the grain export business. To the extent that better production estimates allowed easier entry into the grain trade, it would help work against the development of a noncompetitive market structure.